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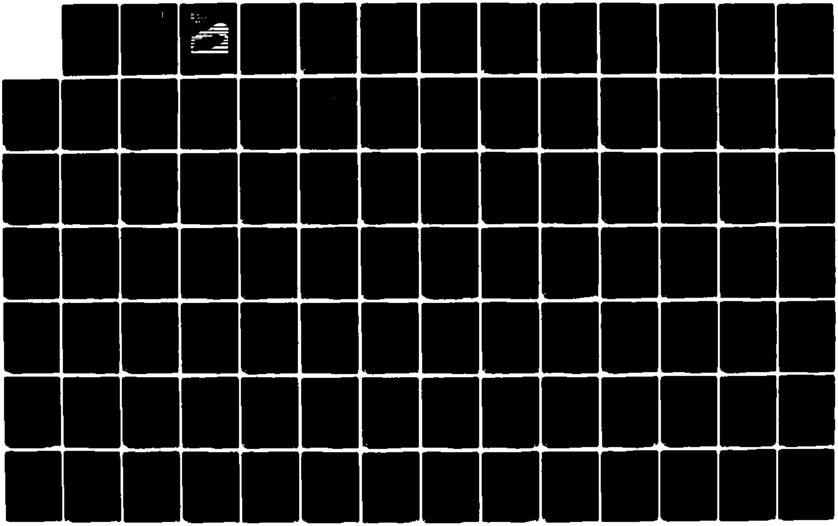

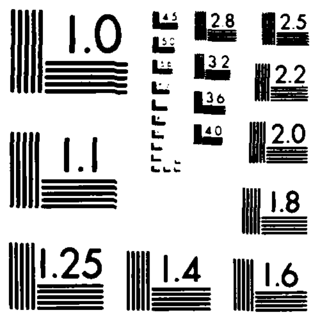

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Blue Mountain Lake

An Archeological Survey and an Experimental Study of Inundation Impacts

by Thomas J. Padgett

Arkansas Archeological Survey
Research Report No. 13

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Report contains description of the resources recorded during the shoreline survey (drawdown status) and emplacement of sites (in situ) to determine effects of inundation on archeological or historical sites.

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BLUE MOUNTAIN LAKE:

AN ARCHEOLOGICAL SURVEY AND AN EXPERIMENTAL STUDY OF INUNDATION IMPACTS

by

Thomas J. Padgett

ARKANSAS ARCHEOLOGICAL SURVEY

RESEARCH REPORT NO. 13

February 1978

ABSTRACT

During August, 1977, the Arkansas Archeological Survey conducted a field study for the Corps of Engineers, Little Rock District, of portions of Blue Mountain Lake in west central Arkansas exposed by a lake drawdown project. Thirty-nine archeological sites were recorded during the study, one of which, 3LO59, may, with additional testing, yield information important to the prehistory of the region. All of the sites recorded have suffered some physical damage due to 30 years of freshwater immersion, and many have been depleted by relic collecting during this and previous drawdowns.

A separate experimental study designed to test certain effects of inundation upon archeological sites was performed. The experiment involved creating archeological context situations for a variety of artifacts and features in an area to be inundated, and conducting preliminary analyses upon the materials used as a basis for post-inundation comparison. The study was designed to correspond with the Reservoir Inundation Studies Project being conducted by the National Park Service, and provide comparative data for studies carried out at archeological sites in other reservoirs.

ACKNOWLEDGMENTS

A number of people aided in this study in many ways. Corps of Engineers personnel--Mr. Shores and Mr. Ellington at the Blue Mountain Dam Office and Mr. Spann at the Little Rock District Office--provided assistance during both phases of the project. Dr. Thomas Rokobe provided us with the use of specialized equipment at the University of Arkansas Agricultural Engineering Laboratories. Dr. Jerome Rose provided use of the physical anthropology laboratories at the University of Arkansas and also provided some of the specimens used in the experimental study. Samples of shell were donated by Robert Ray; lithics by Mickey Sierzchula. Other samples for the experimental study were acquired through the cooperation of Peggy Hoffman, Charles Preston and Sarah Feldbauer of the University Museum. Michael Million donated a replica of a Mississippian jar for the experiments. Dan Morse provided the Zebree specimens. Daniel Lenihan, Toni Carrell and Sandy Rayl of the NPS Inundation Studies Team, provided ideas as well as encouragement for the experimental study. Mike Hoffman provided aid and advice on numerous occasions.

Sandy Blaylock and Lynn Boyd were crew members for the survey of Blue Mountain Lake, and Chip McGimsey and Steve Cochran made up the crew for the experimental study. Lab processing was done by Terry Pfutzenreuter and Jim Duncan. Sandra Scholtz offered advice on setting up statistical tests. Jane Kellet did the figures for this report and designed the cover. Typing was done by Terry Bremer, Mary Lynn Kennedy, and Dorothy Butler.

Dan Wolfman is the Survey Archeologist at the Arkansas Archeological Survey Station at Arkansas Polytechnic College in Russellville where duplicate records of both these studies are curated. In addition, Wolfman had considerable input into the portions of the experimental study which deal with archeomagnetic and alpha track dating methods.

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PART I

AN ARCHEOLOGICAL RESOURCES SURVEY OF THE EXPOSED LAKE BOTTOM AT BLUE MOUNTAIN LAKE, ARKANSAS

This report was prepared for the U.S. Army Corps of Engineers, Little Rock District, under Purchase Order Number DACW 03-77-M-1068

MANAGEMENT SUMMARY

PURPOSE OF THE REPORT

The report is provided to the U.S. Army Corps of Engineers, Little Rock District by the Arkansas Archeological Survey, in fulfillment of Purchase Order DACW03-77-M-1068. It details the findings of a cultural resource survey of Blue Mountain Lake which was carried out in August, 1977, during a drawdown of the lake which exposed major portions of the lake bottom.

OBJECTIVES OF THE STUDY

The survey of Blue Mountain Lake was designed to locate, record, and assess the archeological and historical sites in the exposed portion of the lake. In addition, observations were made pertaining to the effects of the lake operations upon the sites. Major goals of the study were to determine if any sites were eligible for inclusion on the National Register of Historic Places and to make recommendations for additional data recovery and/or preservation as appropriate.

CONSTRAINTS ON THE INVESTIGATION

The survey was limited to some degree by the tall grasses which were planted in the area by the Arkansas Game and Fish Commission. This grass, seeded in June, 1977, as a water turbidity control measure, varied in height from 1 to 6 feet. Inspection of bare ground where the grass did not root, and limited shovel testing were the main site survey techniques. Much of the grass seed, however, had apparently washed off ridges and high spots and tended to collect in low areas such as sloughs and filled-in channels. Therefore, although some sites may have gone undetected, most areas of high site location probability were sufficiently free of vegetation to allow some ground inspection.

Another problem encountered was the amount of nonprofessional relic collecting which occurred previous to and during the fieldwork. This resulted in loss of diagnostic artifacts and information about the sites.

STUDY RESULTS

Thirty-nine archeological sites were recorded during the study, representing both prehistoric and historic occupation of the area prior to the construction of Blue Mountain Dam. The sites vary in size from isolated finds of one artifact to large scatters of cultural material covering several acres. All of the sites have experienced some degree of damage as a result of 30 years of inundation. Many have also been depleted of cultural material by collectors and have suffered damage by unauthorized digging. The expected potential of these sites to provide information pertaining to the prehistory of the area is therefore limited.

One possible exception is site 3LO59, which appears to have suffered less disturbance than the other sites at Blue Mountain Lake. This site is located at the edge of the normal pool level of the lake and is largely shielded by a stand of trees. Ceramics similar to those found in Fourche Maline sites in other parts of western Arkansas and eastern Oklahoma were recorded from the surface of this site.

The Blue Mountain Lake area was assessed as a site for an experimental study of the effects of inundation upon archeological materials. This study (see Part II) will be conducted through a cooperative agreement between the National Park Service, Inundation Study, and the Arkansas Archeological Survey.

SIGNIFICANCE OF THE STUDY RESULTS

The archeological survey of Blue Mountain Lake succeeded in documenting both the extensiveness of the prehistoric and historic occupation of this portion of the Petit Jean River Valley and the apparent disturbance of the archeological record of these occupations. The study of settlement-subsistence patterns in the Ouachitas and Arkansas Valley regions is of concern to archeologists working in Arkansas and Oklahoma, and this survey has added some new information, especially in the spatial distribution of Fourche Maline sites.

RECOMMENDATIONS

Test excavations at site 3LO59 should be conducted if clearing or development of the area around that site threaten it with exposure to physical damage. Test excavations should provide data on the integrity of the site as well as composition and therefore should furnish enough new information to ascertain the site's eligibility for National Register listing. Based upon present data, none of the other sites at Blue Mountain Lake would be considered eligible for nomination to the National Register of Historic Places.

Archeological investigations of lakes during drawdown periods can be accomplished with greater efficiency if the archeological study is planned well ahead of the drawdown date. This would allow scheduling of the fieldwork to coincide with initial phases of the drawdown. Measures could also be taken to control relic collecting on federal property if plans are made in advance.

The inundation study planned for Blue Mountain Lake should provide a considerable body of information on the effects of inundation upon cultural resources such as prehistoric and historic archeological sites. This study will have application not only to Blue Mountain Lake, but to other similar situations of freshwater immersion of archeological materials. It is recommended that the Corps of Engineers personnel at Blue Mountain Lake provide security for the inundation study experimental site to guard against loss of data through vandalism.

INTRODUCTION

PROJECT BACKGROUND

The archeological survey of Blue Mountain Lake came about as a result of a lake improvement project carried out by the Arkansas Game and Fish Commission and the Corps of Engineers. Beginning in June, 1977, the lake was drawn down to a level approximately 10 ft below normal, exposing 1,500 to 2,000 acres of normally inundated land. This was done in order to establish a grass cover on the exposed lake bottom as a means of decreasing turbidity in the lake. This drawdown afforded the opportunity to conduct an archeological survey of a large portion of the lake which is normally not accessible for surface reconnaissance. The survey was completed by the Arkansas Archeological Survey under Purchase Order #DACW03-77-M-1068, issued by the Little Rock District, Army Corps of Engineers.

Blue Mountain Lake was created in 1947 by the construction of an earth and rock filled dam on the Petit Jean River at river mile 74.4. The lake is normally operated at a conservation pool elevation of 384-387 ft above mean sea level (amsl), which inundates an area of 2,900 acres. A considerably larger area, 11,000 acres, is contained within the lake boundaries at the flood control level, 419 ft amsl.

Since the lake was created prior to the enactment of federal conservation legislation such as the Reservoir Salvage Act of 1960 (construction began in 1940 and was completed in 1947), no scientific investigation of the archeological and historical resources of the project had ever been accomplished. However, there have been reports from local citizens that large numbers of archeological specimens have been exposed during previous lake drawdowns, and similar reports were made during the initial stages of the current drawdown project. This archeological project was initiated in August, 1977, in order to document and assess the archeological resources in Blue Mountain Lake.

SETTING

Blue Mountain Lake is located in Logan and Yell counties, in the western central portion of Arkansas. The dam is located midway between the cities of Booneville and Danville, and one mile south of the town of Waveland (Fig. 1). The lake is situated between two national forests, Ozark National Forest to the north and Ouachita National Forest to the south.

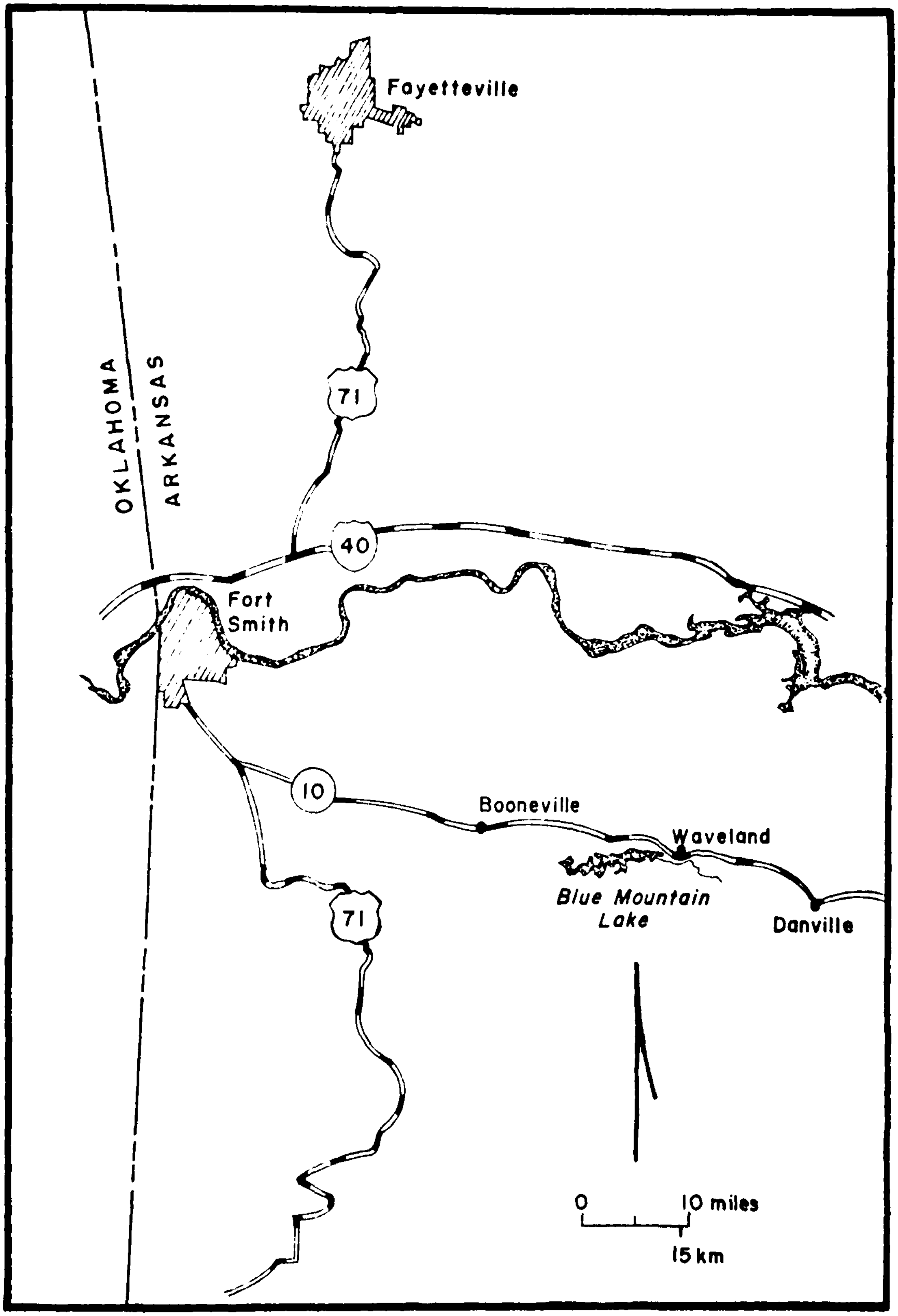

Figure 1. Location of Blue Mountain Lake.

The area is on the northern edge of the Ouachita Mountains and marginal to the Arkansas Valley (Fig. 2). These regions are physiographically grouped together as a province of the Interior Highlands. The local area is characterized by east-west trending ridges. A few miles north of the lake is Magazine Mountain, at an elevation of 2,823 ft amsl. and running along the northern edge of the lake is Pott's Ridge, with elevations ranging from 600 ft to 900 ft. Rock strata forming these ridges are the lower part of the Atoka formation of middle Pennsylvanian age, comprised of shale, sandstone, and siltstone (Halley 1966, Halley et al. 1976). The soils of the area have formed in material weathered out of these rocks. Along the Petit Jean River Valley the soils are primarily Pope Silt Loam and Pope Fine Sandy Loam, alluvial soils derived from sandstone and shale, with smaller areas of Waynesburo Loam, Hanceville Loam, and other types. The Pope Silt Loam is a brown to reddish brown color about 6 in. thick underlain by yellow silty loam clay (Deeter and Loundsbury 1917:30). In portions of Blue Mountain Lake the topsoil loam has eroded away exposing the yellow subsoil. The Pope Fine Sandy Loam is a very deep, excessively drained soil (Deeter and Loundsbury 1917:31).

Upland forest, with a pine-oak dominant association, is the principal vegetational cover in the region. Yellow pine is in abundance today due in large part to commercial lumbering activities which have favored pine over native hardwoods. The alluvial valleys have more hardwoods growing today than are found in the uplands, and species of oak (*Quercus*) and hickory (*Carya*) often dominate these areas (Braun 1967:174). At Blue Mountain Lake, willows (*Salix sp.*) are found along the regular lake shoreline, especially in flatter areas which are frequently flooded. A number of large stumps of black walnut (*Juglans nigra*) are found on the lake bed, usually along the stream banks, visible during the drawdown.

The Petit Jean River flows eastward through both Logan and Yell counties, eventually to join the Arkansas River at a point approximately mid-way between Russellville and Morrilton. The major tributary streams joining the river at Blue Mountain Lake are Cedar Creek, Lick Creek, and Sugar Creek on the south, and Ashley Creek and Crow Creek on the north. It should be noted that different creeks may have identical names in the area, which complicates the use of old records of historical and archeological sites. For example, there are two "Lick Creeks" in the area, one which empties into the lake in Yell County and one which empties into the river in Logan County; there are two "Cedar Creeks", one which empties into the lake in Logan County and one which joins the outflow from the lake in Yell County. It should also be noted

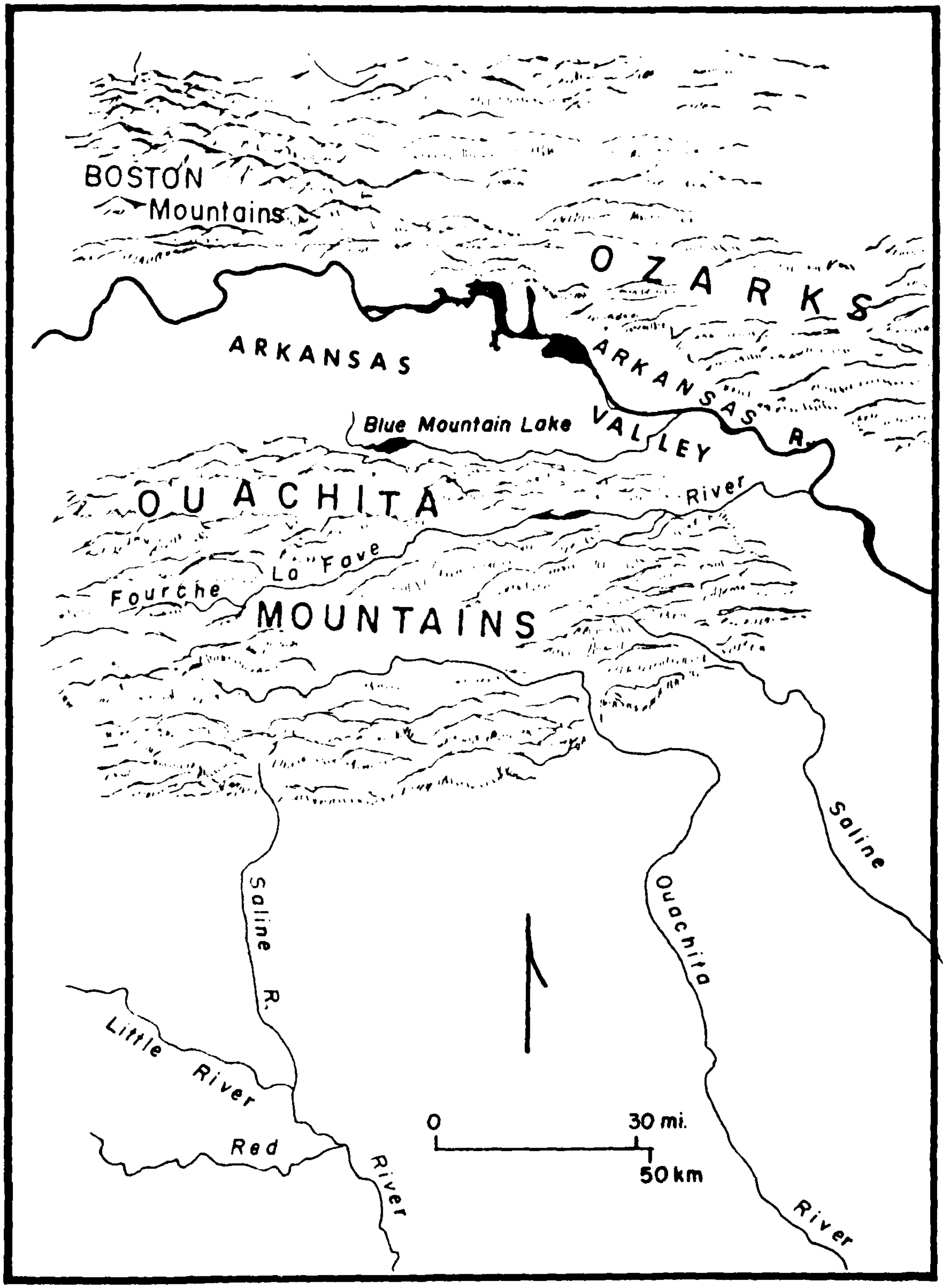

Figure 2. Physiographic Regions.

that the Petit Jean River was referred to as Petit Jean Creek prior to 1939 and that designation is sometimes still heard today.

CULTURAL HISTORY

There are several published reviews of the culture history of the region which includes Blue Mountain Lake (Bartlett 1963; McGimsey 1963; Hoffman 1969; Wyckoff 1970) but a brief sketch of the major stages will be helpful here to place the cultural resources of Blue Mountain Lake in context. The terminology used here follows Wyckoff (1970), who was fairly successful in reordering the variety of taxonomic units and cultural labels which have been applied in this region into the generalized classificatory stages defined by Griffin (1967) for eastern North America.

Paleo Indian (ca. 11,000-8,000 BC): This is generally accepted as the earleist stage of human occupation in North America that has been adequately documented (Williams and Stoltman 1965). Social organization during the Paleo Indian stage is characterized as being based upon small, nomadic family based bands which pursued game including now extinct species of late Pleistocene megafauna (mammoth, mastodon, bison antiquus). The tools these people used included distinctive "fluted" projectile points. Davis (1967:2) illustrates one of these points which was found in Logan County. Baker (1974) reported another one in a private collection in the area, and Ray (1961) reported one from LeFlore County, Oklahoma, located just west of the headwaters of Petit Jean River.

Archaic (8000 BC-AD 1): The Archaic is usually subdivided into early, middle, and late periods which can be seen as the gradual progression into a more sedentary lifestyle and continued adaptations to changing environments. Seasonal exploitation of available plant and animal foods, with scheduled occupation of sites reflecting an annual cycle, is often detectable in the archeological record in areas where sufficient detailed research has been carried out (cf. Winters 1969). Fairly large, triangular bladed knives and/or dart points, in a variety of styles or types, were used, as were chipped and, later, grooved stone axes, ataltl weights, and grinding stones. Evidence of Archaic occupations is widespread in the area, but excavations of Archaic sites (e.g., Bartlett 1963) have been few in number.

Woodland (AD 1-1000): The Woodland stage represents the advent of major cultural changes such as the widespread use of ceramics, sedentary or semi-sedentary villages, burial in earthen mounds, and, in some cases, the establishment of extensive trade networks. In this area the Woodland is represented by the Fourche Maline culture (Fourche Maline *complex* or *focus* as it is often referred to) which has been defined fairly recently (Bell 1953). One of the local subdivisions of Fourche Maline, the Gober phase (Hoffman et al., n.d.) has been recognized in the Arkansas Valley. Characteristic artifacts include plain, grit or clay tempered pottery (Williams Plain and variants), large chipped stone spades, usually made of gray quartzite (argillite), and Gary projectile points.

Mississippian (1000-1700 AD): The Caddoan culture is the major, and perhaps only truly Mississippian development in this area, and it seems to be related to Fourche Maline (Orr 1952; Wyckoff 1970). The large ceremonial center at Spiro, Oklahoma, was occupied during the earlier periods of the Mississippian. Diagnostic artifacts include engraved, painted, and/or polished pottery tempered with shell, bone, or grit; ceramic long stemmed pipes; engraved shell; copper ornaments; and small arrow points. A few sites in eastern Oklahoma have been excavated which had both Caddoan and Fourche Maline components (Proctor 1959). The Fuller and Judy site, near Waldron, Arkansas, had a Caddoan occupation superimposed on Fourche Maline (Hoffman, personal communication) but the excavations at that site have not been published to date. Two other "complexes" have been postulated for the Arkansas Valley area north of the Ouachitas which appear to be Mississippian but may be considered late Woodland stage with some Mississippian traits. More research must be carried out to ascertain exactly where they fit in. These are the "McClure Complex" and the "Carden Bottoms Complex" (Hoffman et al., n.d.).

Historic (late 1700s-present): The Quapaw Indians claimed much of the land below the Arkansas River, although they were concentrated in the area around the mouth of the Arkansas. The Caddo Indians were, at the time of contact, occupying the Big Bend area of the Red River (McGimsey 1969:42) and probably claimed most of the Ouachitas. White traders undoubtedly ventured up the Arkansas River in the 1700s but left little trace of their wanderings. There is one romantic tale of the pirate, Jean Lafitte, leading an expedition into the area in 1816 in search of gold (Banks 1959). Several eastern tribes received land in the area during the early 1800s, but most were removed by the 1830s. Dardanelle was one of the first towns settled in western Arkansas, perhaps as early as 1797. Roads in the area were few during the early 1800s, but keelboats traveled the Petit Jean River and other large streams. Magazine was founded in 1830 and by 1840 had a population of 241 (Banks 1959). The area has always had a rural farming and ranching economy, and this is still the case today, although many small industries have moved into the area recently. Very little has been written of the history of this area. Available sources include Banks (1959), Hemstead (1890), and the *Biographical and Historical Memoirs of Western Arkansas* (Anonymous 1891).

PREVIOUS ARCHEOLOGICAL RESEARCH

The first archeological expedition into the area was made by Warren K. Moorehead, who traveled up the Arkansas River on several trips for the Phillips Academy, Andover, Massachusetts (Moorehead 1931). Moorehead illustrated many artifacts from Yell County, but his report is of limited use. However, that report does contain a map prepared by a Yell County resident, Mr. C. B. Franklin, which shows a number of sites in the county, including some in the area of Blue Mountain Lake, described as a "Series of village sites, mostly on the north side of Petit Jean, extending west to lowlands in Logan County, very prolific in specimens of all kinds" (Franklin, cited in Moorehead 1931:13).

At approximately this same time, 1927, the University of Arkansas was given a ceramic jar which came from the area around Sugar Grove, Logan County. The vessel is a flat bottomed jar with constricted neck and excurvate rim (Williams Plain). There are two other vessels accessioned with this pot, but there is some uncertainty as to their provenience. They are both Caddoan vessels, one bottle and one small bowl.

More recently, a survey of the Dardanelle Reservoir was undertaken before dam construction by Robert Greengo (1957). A survey of the Ozark Lake area was completed and some sites were tested before that lake was completed (Hoffman et al., n.d.). Much of the data on Fourche Maline was derived from four excavated sites in Wister Reservoir, which was surveyed in 1946 (Bell 1953). A survey of South Fourche Creek watershed recorded five small sites (Flenniken 1974) and a survey of areas in the Poteau River watershed found some historic sites, but no prehistoric ones (Padgett 1976a) Surveys and test excavations have been carried out in areas of the Upper Petit Jean River watershed (Baker 1974; Rolingson 1974) where, among other sites, a bluff shelter was briefly tested (Padgett et al. 1976). In the upland areas, recent surveys have revealed a very light site density, with most of the sites representing small hunting camps (Brooks 1976; Imhoff and Mathis 1976; Imhoff 1976).

GOALS OF THE PROJECT

The goals of the archeological survey of the Blue Mountain Lake were straightforward: to conduct a survey of the exposed areas of Blue Mountain Lake, record the archeological sites present, and report to the Corps of Engineers the significance of the archeological resources, the effects of the lake operations upon these resources, and recommendations for site preservation and protection. An ancillary goal was to assess portions of the lake as possible loci of experiments on the impacts of inundation upon archeological materials. These inundation experiments will be conducted in cooperation with the Interagency Inundation Studies Team, National Park Service, Santa Fe, New Mexico. A copy of the prospectus for this separate study is included in this report as Appendix A.

LIMITS OF THE STUDY

The survey covered only the area of the lake bottom exposed by the drawdown, approximately 1,500 to 1,800 acres. This included, for the most part, the area from the dam west to approximately the Cedar Creek area in Logan County. West of Cedar Creek the lake is largely bound by the banks of the Petit Jean River and the drawdown only lowered the water level in the channel. A few low areas between Cedar Creek and Hise Hill were checked, but the survey did not go further west than Hise Hill. The broad flat area below the dam was not completely exposed, and was covered with water ranging from several inches to several feet deep. Water level at the time of the survey was approximately 375 ft amsl and the surveyed area ranged from this elevation to the normal lake level of 387 ft amsl (Fig. 3), which was usually distinctly marked. The elevations of archeological sites could be accurately estimated by reference to these points.

The major limitation in surveying this area was the grass which was planted by the Arkansas Game and Fish Commission. This was a sorghum-sudan grass mix which was 6 ft high in places, obscuring the ground surface. However, this grass has taken root better in low lying areas such as old stream channels and sloughs than upon slightly higher areas like levee ridges, and there were numerous areas where the grass did not take root, which afforded glimpses of the ground surface.

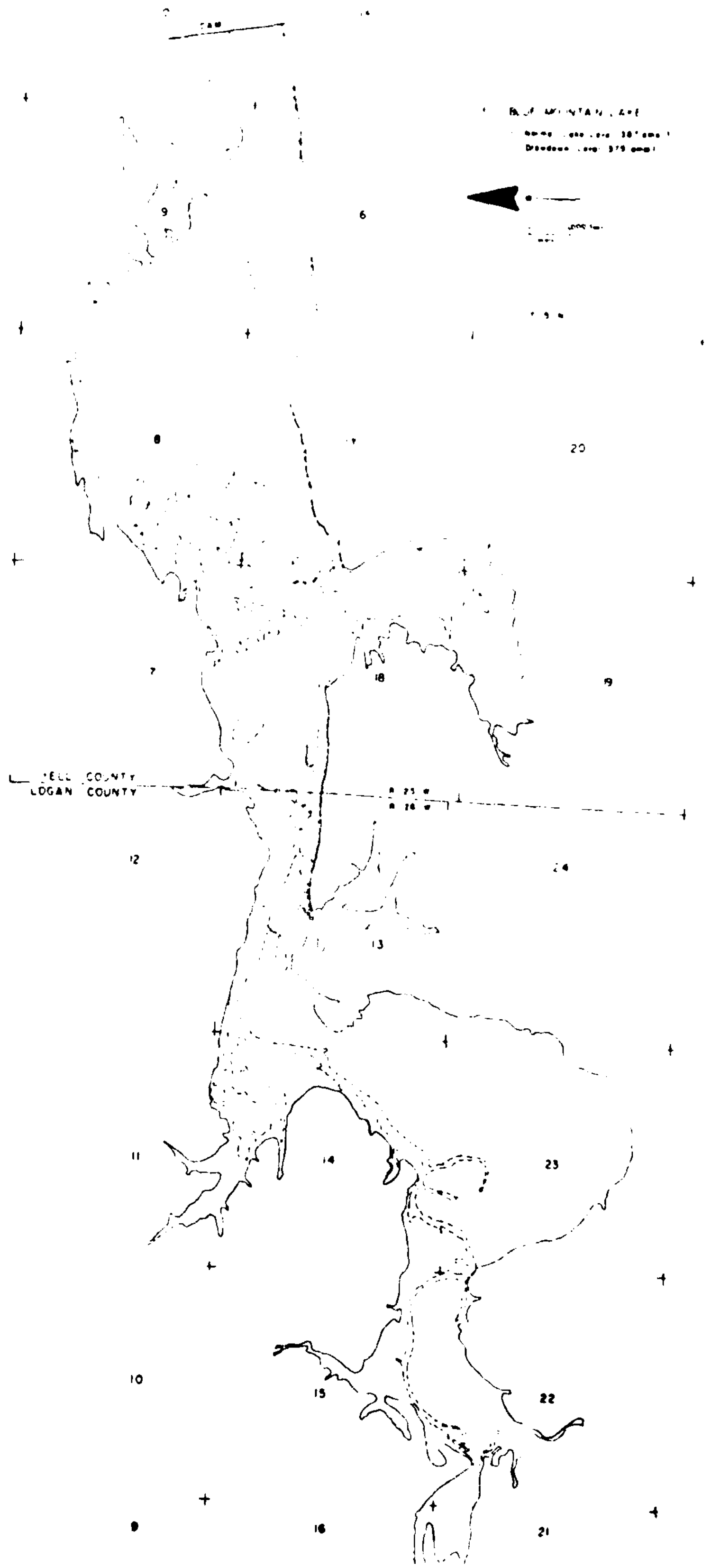

Figure 3. Exposed Lake Bottom, Blue Moun:ain Lake.

SURVEY TECHNIQUES

Access to the area was accomplished by boat and by truck. The boat offered the best means of travel around the lake, although the shallow water meant constant running aground and tedious poling across flats. The ground reconnaissance was carried out by the archeologist and two assistants. Shovel testing was used sporadically to check for archeological deposits in areas of heavy ground cover. Pot holes dug by local collectors were also examined for archeological materials.

Spatial control was maintained through the use of USGS topographic maps, Corps of Engineers project planning maps, and a Brunton pocket transit. The Corps of Engineer maps were extremely useful since they were completed before the dam project and showed the area in large scale with 5 ft contours marked. Site locations were marked on these maps in the field, then later transposed to USGS 7½ minute quad sheets.

Surface collections were made from all sites except one (see page 28). Whenever there appeared to be distinct clustering of material, each cluster was collected and bagged separately and given an area designation. The material was washed, processed, and analyzed at the laboratories of the Arkansas Archeological Survey in Fayetteville and will be curated at the Survey station at Arkansas Technological University in Russellville.

SITE DESCRIPTIONS

NATURE OF THE ARCHEOLOGICAL RESOURCES

Most of the artifacts recovered during this project have been inundated for 30 years, with only brief periods of exposure. The effects of this freshwater immersion will be detailed in another section of this report, but some apparent effects should be mentioned here. Amateur archeologists familiar with the sites at Blue Mountain Lake from previous drawdowns reported a lack of prehistoric ceramics in the project area. This may have been due to a lack of recognition of these artifacts. Many potsherds found during this survey had a weathered, patinated appearance identical to the many small pieces of sandstone native to the area. This patination effect was also noted on the lithic artifacts, and, while chipped stone was usually easily distinguished from native rock, the patination made it difficult to separate chert from novaculite.

In addition to the prehistoric ceramics and lithics mentioned above, quite a large amount of historic period material was present in the project area, as would be expected since a number of farms and homesteads were located in the river valley. Historic material ranged temporally from pre-Civil War to recent trash dumped into the lake. The latter was not quantified for this report.

In addition to the sites mentioned by Moorehead and discussed previously in this report, one archeological site was on record as being located within the project area. This site was recorded in 1961, but could not be relocated during this survey using the legal description given on the site form. It is possible that site 3LO60, recorded during this survey is the same as this previously recorded site (see page 22). There are four other sites on record which are located in the Blue Mountain Lake area, but since they were not within the exposed conservation pool acreage they were not revisited during the fieldwork. These should be re-examined in any survey of the floodpool acreage.

3LO40

Description: This is a small lithic scatter which is eroding at the perimeter of the normal lake level. Scrub growth and a few willow trees cover the area of the site which is usually above water and the yellow sandy clay soil containing artifacts has washed out to a distance of approximately 10 m. A small stream originally ran about 250 m east of this site.

Discussion: Original dimensions of the site could not be determined, much erosion has taken place.

Material Collected: 53 pieces of chipped stone, primarily chert and novaculite flakes.

Chronological Position: Unknown

3L041

Description: The site is a small lithic scatter located on a slight rise about 300 m south of the Petit Jean River Channel but now normally at the shoreline of Blue Mountain Lake. Material was collected from a 10 m x 20 m strip of yellow sandy clay that was washing out of a small embankment marking the lake level. Scrub growth covers top of embankment.

Discussion: Most of the site is probably eroded.

Material Collected: 29 chert and novaculite flakes and 2 biface fragments.

Chronological Position: Unknown

3L042

Description: Located approximately 100 m southeast of 3L040, this site is very similar in appearance to that site. It is located at approximately the 385 ft contour and consists of a yellow sandy clay eroded slope approximately 350 m south of the river channel.

Discussion: Some cultural material extends into willow-scrub vegetation above the normal lake shoreline.

Material Collected: 16 chert and novaculite flakes and 1 biface fragment.

Chronological Position: Unknown

3L043

Description: This site is approximately 100 m south of 3L042, on the east side of the small low peninsula formed by the lake waters backing up into the stream channels of two tributaries of the Petit Jean River. Normally the site is at the lake's edge, and is eroded.

Discussion: Site 3L042 may be a related site, although there is no apparent physical connection between the two lithic scatters.

Material Collected: 7 chert flakes

Chronological Position: Unknown

3L044

Description: This site is situated on the north bank of the Petit Jean River at a confluence with a tributary stream which enters the river from the northwest. Elevation of the site is approximately 380 ft amsl and it is characterized by large sandy spots of brown soil among the newly planted sorghum and sudan grass.

Discussion: Area had been previously collected by nonprofessionals.

Material Collected: 11 chert and novaculite flakes, 1 biface fragment

Chronological Position: Unknown

3L045

Description: A 15 x 15 m open space of reddish yellow sandy clay marked this site, which is located on the north side of the Petit Jean River Channel, at the 380 ft contour.

Discussion: Scarcity of lithics may be due to previous collectors.

Material Collected: 10 chert and novaculite flakes, 3 bifaces, 5 grit-tempered plain potsherds.

Chronological Position: Woodland - Fourche Maline

3LO46

Description: When this site was visited, it appeared to be eroding severely into Crow Creek. A large lithic scatter, this site stretches from the banks of Crow Creek to the foot of a small rocky ridge, covering an area of about 90 x 60 m, on the 385 ft to 390 ft contours.

Discussion: The site is exposed to wave action at normal lake level.

Material Collected: 62 chert and novaculite flakes, 4 bifaces, 3 projectile point fragments.

Chronological Position: Unknown

3LO47

Description: Located on the southern side of the Petit Jean River, this is a site covering about 100 x 50 m with some fairly distinct areas of reddish yellow sandy clay exposed in the tall grass. Elevation is approximately 380 ft amsl.

Discussion: There was one freshly dug pothole at the site when it was visited, indicating that collectors had been there.

Material Collected: 26 chert and novaculite flakes, 4 biface fragments, 2 Gary type projectile points, 6 grit-tempered plain potsherds.

Chronological Position: Woodland - Fourche Maline

3LO48

Description: This site is normally a small low island with a few small trees and shrubs which are apparently frequently inundated when the lake level exceeds 387 ft. The northern part of the island contained historic as well as prehistoric materials. The site is on the (south) west bank of the river (as the channel turns northward at this point). The "island" is a natural levee ridge remnant.

Discussion: Some erosion is occurring, primarily along the bank.

Material Collected: 68 chert and novaculite flakes, 3 biface fragments, 4 historic period artifacts.

Chronological Position: Unknown prehistoric; late historic.

3LO49

Description: The location of this site is on the perimeter of the lake along an eroding embankment of yellow sandy clay. The Petit Jean River channel is now about ¼ mile to the east, although previous channels have run much closer to the site, as is evidenced by filled-in sloughs between the high ground the site is on and the current channel. The site measures about 15 x 30 m.

Discussion: A beach is forming as soil (and artifacts) are eroding from the bank.

Material Collected: 83 flakes, 9 biface fragments, 1 Carrollton or Bulverde point.

Chronological Position: Late Archaic

3LO50

Description: This is a rather long, almost "L" shaped site located on natural levee remnants which parallel the southern bank of the Petit Jean channel. The site dimensions are 400 x 20 m. A cluster of historic period artifacts probably indicate the trash from a house which is shown on the 1938 map in the middle of the site. Soil is dark brown sand.

Discussion: Local collectors observed at this site after it was recorded. The area of historic artifacts was collected and accessioned separately.

Material Collected: Woodland - Fourche Maline: late historic

3LO51

Description: At the time that this site was visited in the summer of 1977, it was a small island in Crow Creek, with a small amount of scrub growth on the highest point, which indicates that at least some of the island is exposed most of the time when the lake is filled. The island was no more than 35 m in diameter.

Discussion: Erosion is severe and artifacts were found only along erosional margins of the island.

Material Collected: 12 flakes, 1 chert preform

Chronological Position: Unknown

3LO52

Description: This site was located immediately west of 3LO51 on a smaller, lower island which is approximately 577 ft amsl. The island was bare and sandy, about 15 m in diameter.

Discussion: There is little, perhaps nothing, left of this site.

Material Collected: 2 flakes, 1 biface fragment, 3 pieces of baked clay daub (lost in processing).

Chronological Position: Unknown

3LO53

Description: Located on the north side of the Petit Jean River channel, extending back from the bank to the treeline which marks the lake boundary, this site is a very thin scatter of chipped stone. Much of the area was covered with newly planted grass and sorghum, with a few bare spots of brown sandy soil.

Discussion: Erosion has affected the area little, except at treeline and river bank.

Material Collected: 13 flakes of novaculite and chert, 1 biface fragment.

Chronological Position: Unknown

3LO54

Description: This site is marked by fine yellow silty sandy clay at the junction of the Petit Jean and a creek which enters the river from the north. The site extends back from the river bank and up the creek bottom about 100 m. Heavy vegetation covers the area above the lake perimeter, which is marked by a rock beach.

Discussion: Some silting has occurred with erosion. Historic sherds may be secondary deposition.

Material Collected: 1 Gary type point, 2 quartz crystals, 2 pieces of white china plate, 15 flakes.

Chronological Position: Possibly late Archaic or Woodland; possible historic component.

3LO55

Description: Located on the southern side of the Petit Jean River channel, in the area of Hog Island, this is a fairly large site (approximately 60 x 15 m). Much of this site was covered with newly planted grass, but large bare spots showed yellow sandy clay soil. Elevation of the site ranges from about 380 ft to 385 ft amsl.

Discussion: One large sandstone metate fragment was found at site but not collected.

Material Collected: 27 flakes, 5 biface fragments, 1 Castroville point, 1 historic period sherd

Chronological Position: Late Archaic, possibly late historic.

3LO56

Description: This site is on the south side of the Petit Jean River channel, west of site 3LO55. Cultural material was washing out of a red clay embankment. Heavy vegetation covers the upper part of the embankment.

Discussion: This site may be the same as 3LO19, previously reported by an amateur, but heavy erosion and bank cutting have altered the appearance of the site.

Material Collected: 15 flakes, 2 biface fragments.

Chronological Position: Unknown

3LO57

Description: Site 3LO57 is located on a sandy levee remnant of the Petit Jean River on the southern side of the channel.

Cultural material extends for about 40 m along the bank. The surrounding low areas were covered with tall grass.

Discussion: Site is eroding along the bank.

Material Collected: 1 Gary point base, 3 unidentified point fragments, 43 flakes and biface fragments.

Chronological Position: Late Archaic or Woodland.

3LO58

Description: This is a large site covering about 5-10 acres on the southeastern side of Ho[illegible] Island. Most of the site is wooded, some is in pasture, with some eroded areas where normal lake level reaches. The site overlooks an abandoned channel of the Petit Jean River called Richey's Slough.

Discussion: The majority of this site is above normal lake level.

Material Collected: 3 flakes, 1 point fragment, 1 preform, 2 unidentified fragments.

Chronological Position: Unknown

3LO59

Description: This is another large site, located on the southern bank of the Petit Jean River channel and Blue Mountain Lake. Most of the site is on a wooded rise which is above normal lake level. The eastern portion of the site faces a low area which probably is a filled-in abandoned channel.

Discussion: Except for the river bank, this site has not suffered from erosion to any great degree, and probably has not been extensively collected by amateurs.

Material Collected: 52 flakes, 1 Gary Point, 3 point fragments, 7 biface fragments, 2 shell tempered sherds, 31 clay tempered sherds, 3 grit tempered sherds, 1 sand tempered sherd, 1 hammerstone, 1 pitted cobble, 1 grooved abrader.

Chronological Position: Woodland - Fourche Maline.

3LO60

Description: This is a small lithic scatter located on a sandy levee remnant on the southern side of the Petit Jean River channel.

Discussion: The area appears to be very washed and eroded.

Material Collected: 12 flakes, 2 projectile point fragments, 1 uniface end scraper, 2 biface fragments.

Chronological Position: Unknown.

3YE36

Description: This site is located on a high area on the west side of Lick Creek. An historic homestead once occupied the site, and a row of seven pecan trees still stand along the property line. A 3 m bluff marks the edge of the lake at normal levels and cultural material is eroding out of the bank.

Discussion: Most of the site is above normal lake level.

Material Collected: 55 flakes, 2 biface fragments, 1 point fragment, 7 historic period sherds (mostly earthenware), 1 glass miniature bottle, 1 iron plow fragment.

Chronological Position: Unknown prehistoric; late historic.

3YE37

Description: Located on the west side of Lick Creek, this site is eroding out along about 40 m of an embankment of yellow clay on the shoreline of the lake. The shoreline curves around a small point formed by bends in Lick Creek, which is now covered by the lake at normal levels. The area above the embankment is lightly wooded.

Discussion: Erosion is severe, but the portion of the site above the embankment is untouched.

Material Collected: 106 chert and novaculite flakes, 2 biface fragments, 2 point fragments, 4 historic sherds.

Chronological Position: Probably late Archaic, (historic materials are secondary deposits, perhaps from 3YE36).

3YE38

Description: This site is located on a flat point west of Lick Creek at an elevation ranging from 376 to 387 ft amsl. Much of the area was covered with the newly planted grass, but there were large areas of sandy bare spots.

Discussion: Beach formation appears to be in process here.

Material Collected: 20 flakes, 1 corner notched point fragment, 1 side scraper, 8 pieces of historic ceramics.

Chronological Position: Unknown prehistoric; late historic.

3YE39

Description: The original land surface has been altered at this site, which is located on the west side of Lick Creek. Pre-inundation maps show a cemetery plot at the site which is no longer evident and there is a large pile of sandstone rocks at the site which were probably the result of clearing fields for agriculture in the late historic period. The site has prehistoric as well as historic artifacts in abundance, spread over an area of about three acres. Above the lake shoreline is a group of willow trees, and the site extends from there to about the 380 ft contour, with a very slight slope.

Discussion: The site had been visited by unknown collectors prior to our visit.

Material Collected: 8 flakes, 2 pitted cobbles, 6 biface fragments or preforms, 82 historic artifacts.

Chronological Position: Unknown prehistoric; historic--early 1800s to 1900s.

3YE40

Description: This site is located on the southern bank of the Petit Jean River on a series of sandy rises representing a dissected levee ridge. Soil is dark brown sand. Each distinct section of the ridge was collected separately and designated as area A-D.

Discussion: This site was known to many local collectors. Several pot holes were observed. Erosion along the bank of the channel is severe.

Material Collected: Area A - 104 flakes, 1 Gary point, 5 biface fragments, 2 clay tempered sherds, 1 grit tempered sherd, 1 iron bolt. Area B - 19 flakes, 2 biface fragments, 1 Snyder(?) point, 1 Carrolton point, 3 point fragments, 2 clay tempered sherds, 1 sand tempered sherd, 2 historic sherds. Area C - 18 flakes, 1 hammerstone, 1 pitted cobble, 1 Gary point, 1 unidentified point, 1 preform fragment. Area D - 7 flakes, 1 hammerstone, 2 biface fragments, 2 historic artifacts.

Chronological Position: Woodland - Fourche Maline; late historic use of area.

3YE41

Description: A large lithic scatter, this site is a favorite of local collectors and is probably one of the areas collected by C. B. Franklin in the 1920s (Moorehead 1931). It is located on the north side of the river near Ashley Creek. Two large rises at the site are wooded islands when the lake is at normal level. Site covers about 10 acres.

Discussion: See page 9 for discussion of C. B. Franklin. The site was being collected by locals when we visited it.

Material Collected: 276 flakes, 11 preforms, 10 biface fragments, 1 Bulverde point, 1 Trinity point, 8 unidentified point fragments, 5 recent historic artifacts.

Chronological Position: Archaic.

3YE42

Description: A circular wooded island when the lake is filled, this is a rocky outcrop that overlooks the floodplain on the north side of the Petit Jean River channel. The prehistoric materials were confined to the eastern side of the island.

Discussion: This area had been visited by a collector prior to our survey.

Material Collected: 10 flakes, 1 pitted cobble, 10 historic stoneware sherds.

Chronological Position: Unknown prehistoric; late historic.

3YE43

Description: Site 3YE43 is located on the northern side of a island located north of the Petit Jean River channel and east of a tributary creek. This was still an island when it was visited during this survey, although the surrounding water was very shallow. The site is a circular area of yellow clay soil, about 15 m in diameter at an elevation of 375 ft - 380 ft amsl.

Discussion: The small mound of yellow clay is eroded severely.

Material Collected: 26 flakes, 2 biface fragments, 1 point fragment.

Chronological Position: Unknown.

3YE44

Description: The site is located on the north bank of the Petit Jean River channel on the east side of a creek confluence with the river. Soil along the bank is brown sand, grass covers the area back from the bank.

Discussion: Erosion of banks only. See discussion of 3YE46.

Materials Collected: 15 flakes, 2 biface fragments, 5 grit tempered sherds, 4 clay tempered sherds.

Chronological Position: Woodland - Fourche Maline.

3YE45

Description: Site 3YE45 is located on the foot of a ridge on the northern side of the lake at approximately the 380 ft contour. Three circular mounded areas, each about 3 m in diameter and .5 m high had concentrations of lithic debris on their surface, and may have been house mounds. Most of the surrounding area was in tall grass.

Discussion: Some material was found between and around the mounds.

Material Collected: 76 flakes, 7 biface fragments, 1 awl or gouge, 2 point fragments.

Chronological Position: Unknown.

3YE46

Description: This site is on the north bank of the Petit Jean channel on the west side of a stream confluence, opposite 3YE44.

Discussion: 3YE44, 3YE46, and 3YE52 may all be parts of the same site, separated by two streams that join, then enter the river.

Material Collected: 3 flakes, 1 Gary point, 6 clay tempered sherds.

Chronological Position: Woodland - Fourche Maline

3YE47

Description: An isolated find on the south bank of the Petit Jean River channel found eroding out of brown sand along the bank, was assigned this site number.

Discussion: No other material was observed, but it probably existed and has been washed or carried away.

Material Collected: 1 Pulverde point.

Chronological Position: Archaic, possibly early Woodland.

3YE48

Description: This is another site spread out along a levee remnant on the southern side of the Petit Jean channel. Like 3YE40, it was divided into four areas for comparative collection purposes.

Discussion: Erosion along the bank has removed 20-50 cm of soil.

Material Collected: Area A - 15 flakes, 3 grit tempered sherds, 3 clay tempered sherds. Area B - 3 flakes, 2 shell tempered sherds, 1 clay tempered sherd, 3 historic sherds. Area C - 4 historic period sherds. Area D - 12 flakes, 1 clay tempered sherd.

Chronological Position: Late Woodland - Fourche Maline (?); Late Historic.

3YE49

Description: This is a small, eroded site located on the end of small east-west oriented sandy clay ridge that protrudes into cove on the north side of the lake. A few small oaks and willows grow on the ridge.

Discussion: The site is extensively eroded.

Material Collected: 14 flakes.

Chronological Position: Unknown.

3YE50

Description: Another eroded area on the northern side of the lake, this site is a small slope on the same peninsula as 3YE49, but is about 100 m south.

Discussion: Severe erosion and redeposition.

Material Collected: 4 flakes, 1 biface fragment.

Chronological Position: Unknown.

3YE51

Description: This site is located on the southern end of the peninsula in the northern part of the lake in the Waveland area. The ridge which marks this site may be an old levee remnant, but it is about 3/4 of a mile from the present river channel.

Discussion: Most of this site is above the lake level.

Material Collected: 29 flakes, 5 biface fragments, 1 historic sherd.

Chronological Position: Unknown prehistoric; late Historic.

3YE52

Description: Located at the confluence of two streams, joining the Petit Jean River from the north, this site is on a flat, sandy peninsula. Grass cover is thick.

Discussion: See discussion for 3YE46.

Materials Collected: 20 flakes, 2 biface fragments.

Chronological Position: Unknown.

3YE53

Description: This site was barely above the water level, at about 576 ft amsl, and was a completely barren island about 10 m in diameter. It is located at the confluence of Lick Creek and the Petit Jean channel.

Discussion: Two men from Ft. Smith were collecting the site when we arrived.

Material Collected: The two collectors had picked up a biface and several flakes, which seemed to be the only things present on the surface. We made no collection.

Chronological Position: Unknown.

SURVEY RESULTS

ARTIFACT ANALYSIS

A total of 2,052 artifacts were recovered from the 39 sites found during the archeological survey. Of the 1,776 prehistoric artifacts only 104, or about 5%, are identifiable projectile points or ceramics, artifacts that could be termed "diagnostic." The total of identifiable projectile points is particularly small, less than 1%. This is not too surprising, considering the area has a history of nonprofessional collecting activity that dates at least to the 1920s. Although considerable information about human behavior, especially tool manufacturing patterns, can be derived from other artifact categories, the depletion of diagnostic artifacts is a fact that has to be taken into account in dealing with these surface collections. The lithic material from Blue Mountain Lake is listed in Table 1.

The projectile points were classified according to type descriptions contained in Bell (1958, 1960) and Perino (1968, 1971). Many of the artifacts were too fragmentary to assign a type designation and are listed as "unidentified projectile points and fragments." Inclusion in this category was based upon evidence of bifacial pressure flaking on the specimen and the presence of a hafting element or triangular blade shape.

The categories "biface" and "biface fragment" refer to any bifacially worked artifacts which would not fit in the "projectile point" category defined above. Although projectile points are bifaces (i.e., bifacially chipped), the designation is used here to denote preforms or "blanks" which were discarded before the final stages of manufacturing a projectile point or knife. Some edge fragments of bifacially worked tools are included in the category of biface fragment.

Unifacially flaked artifacts include scrapers, spokeshaves, flake blades, etc. Since all the material came from surface collections which were subject to some degree of mechanical disturbance which can create natural uniface edges, a conservative approach was used in analyzing the material, and only artifacts which showed definite, purposeful, flake removal patterns were included in this category.

Primary and secondary decortication flakes were combined in Table 1. They represent the initial stages of cobble reduction to

Table 1. Lithic artifacts.

Site Number	Projectile Points: Gary	Synder	Carrollton	Bulverde	Trinity	Castroville	Unidentified Proj. Pt. & Fragments	Bifaces	Biface Fragments	Unifaces	Uniface Fragments	Decortication Flakes	Interior Flakes	Retouch & Thinning Flakes	Shatter & Fire-cracked	Cores	Pitted s.s. Cobbles	Hammerstones	Abrader	Totals
3L040							3	2	7		2	5	22	1	9	2				53
3L041											2	5	12	9	3					31
3L042											1	1	6	9						17
3L043												2	5							7
3L044									1			2		9						12
3L045									2				2	5	3					12
3L046							1	1	2		1	16	20	18	6					67
3L047	1						1		4			2	19		5					32
3L048								1	2			2	54	8	4					71
3L049			1				5	3	1	1		8	40	24	11					94
3L050*				1			4		8	1		39	76	69	12					210
3L051								1				5	2	4		1				13
3L052									1					2						3
3L053									1			1	3	9						14
3L054	1											6	4	5						16
3L055						1	1	2	2			7	8	11	2					34
3L056									2			10	3	2						17
3L057							4		3			8	19		3					37
3L058							1		3			5	13	9	3					34
3L059	1						3		7			10		31	11		1	1	1	66
3L060							2	1		1		1	3	8						16
3YE36							1		2			6	30	12	6					57
3YE37							2		2			5	51	42	7	1	1			111
3YE38							1			1		4	9	6						21
3YE39							2	1	3				7		1		1			15
3YE40*	2	1	1				6		8			27	51	59	9		1	1		166
3YE41				1	1		8	3	18			74	116	58	16			3		298
3YE42												1	1	8			1			11
3YE43							1		2			4	1	19	2					29
3YE44								1	1			7	4	4						17
3YE45							3		8			[illegible]	21	41	12					87
3YE46	1											1		2						4
3YE47				1																1
3YE48*												6	9	15						30
3YE49												2	5	6	1					14
3YE50												1		1	2					4
3YE51									4			1	12	11	5					33
3YE52									2				16	4						22
Totals	6	1	2	3	1	1	49	16	96	4	6	278	644	521	133	4	5	5	1	1776

*Total tabulation for all areas of the site produce a chert tool, and exhibit portions of the cobble cortex on the dorsal side of the flake. After these flakes are removed, large interior flakes are worked off the piece by percussion (usually with a hard hammerstone), to produce a preform. Thinning and retouch flakes are then taken off the piece in final shaping of the tool. The category "shatter and fire-cracked rock" includes pieces that are blocky and angular, often red or reddish tinted from heat.

Cores are blocks of stone which have had flakes removed, usually in a regular and systematic manner in which the flake removed can be used as a cutting tool with little or no modification. Pitted cobbles are sandstone slabs which have been used as anvils to pound nuts or other items (such as cores), with a hammerstone.

The prehistoric ceramics from the Blue Mountain Lake survey are listed in Table 2. Nine sites had some prehistoric ceramics, mostly clay or grit tempered. No decorated sherds were among the 90 collected. Grit tempering material was usually crushed rock, with one example of crushed quartz crystals up to 5 mm long used for temper. The clay tempering appears to be crushed potsherds (grog) or hardened clay particles. The few shell-tempered sherds had all or most of the shell material leached out.

Table 2. Prehistoric Ceramics.

Site Number	Sand tempered plain body	Grit tempered plain body	Grit tempered plain exc. rim	Grit tempered plain neck	Grit tempered plain base	Clay tempered plain body	Clay tempered plain straight rim	Clay tempered plain exc. rim	Clay tempered plain base	Shell tempered plain body	Shell tempered plain neck	Total
3LO45		5										5
3LO47		6	1									7
3LO50		3		1								4
3LO59	1	3			2	31	1	1	1	2	1	43
3YE40	1		1			4						6
3YE44		4		1		4						9
3YE46						6						6
3YE48			3			2				5		10
Total	2	21	5	2	2	47	1	1	1	7	1	90

Total tabulation for all areas of the site

The historic period artifacts collected during the survey are listed in Table 3. Almost all of the historic material collected is typical of utilitarian ware of the late 1800s, although some, such as feather edge sherds and some of the transfer ware may date to the early 1800s. One piece of the feather edge is green and the remainder are blue. The colors and variety of different transfer ware and painted ceramics are too numerous to list in tabular form and are worthy of a separate study in themselves.

Sites which did not have any ceramics or diagnostic lithic types cannot be temporally classified. The sites which lack ceramics cannot be assigned to a preceramic stage based on negative evidence, since ceramic making peoples create special activity sites such as hunting camps or lithic extraction sites (i.e., "chipping stations") which will not have ceramics. The sites with prehistoric ceramics represent Fourche Maline hamlet or village sites, although the scarcity of surface materials at some of these sites is disturbing. This scarcity is probably due to both the effects of inundation and previous collecting activities. Site 3LO59, most of which is above the normal lake level in a stand of trees, has the largest representation of prehistoric ceramics (Table 2).

Site 3YE48 has the highest incidence of shell tempered ceramics which may indicate that it is temporally later than any of the other sites. The sample from the site is so small, however, including also some clay and grit tempered sherds, that it was considered as late Woodland instead of Mississippian and is probably also Fourche Maline.

It should be also pointed out that the sites located in proximity to old channels of the Petit Jean River were nonceramic sites. One of them, 3LO49, contained a Carrollton point, which has been associated with late Archaic sites in other areas. Geomorphological dating of the relic stream channels of the Petit Jean could provide crossdating for these sites.

LITHIC RESOURCES

In the immediate area around Blue Mountain Lake, sandstone and shale, with smaller amounts of siltstone and quartzite, comprise the available lithic resources. Of the material collected from archeological sites, chert and novaculite predominate (Table 4). The prehistoric peoples utilizing the Petit Jean River Valley were

Table 3. Historic artifacts.

Site Number	Earthenware jar brown glaze	Earthenware jar salt glaze	Earthenware jar white glaze	Whiteware plain plate	Whiteware plain cup	Whiteware plain bowl	Whiteware impressed	Transferware	Featheredge ware	Painted ware	Glass bottles whole & frag.	Glass plate	Other	Total
3LO47													1[1]	1
3LO49	1	1		1							1			4
3LO50*	12			33							3			48
3LO54				2										2
3LO55	1													1
3YE36	3		2	2							1		1[2]	9
3YE37	2							1	1					4
3YE38	1		1	4		1		1						8
3YE39	5	3	3	12	7	4	2	20	7	2	11		5[3]	81
3YE40*		1						1		1	1		1[4]	5
3YE41	1		1								2	1		5
3YE42					6			4						10
3YE48*	3	2						1		1				7
3YE51	1													1
Total	30	7	7	54	13	5	2	28	8	4	19	1	8	186

*Total tabulation for all areas of the site

[1] iron hook

[2] iron plow part

[3] iron horseshoe, ring & bar hook; whiteware doorknob; white milkglass

[4] iron bolt

Table 4. Lithic types.

Site Number	Chert	Novaculite	Arguillite/ Quartzite	Sandstone	Quartz Crystals	Total
3L040	41	12				53
3L041	20	11				31
3L042	10	7				17
3L043	4	3				7
3L044	5	7				12
3L045	7	6				13
3L046	54	15				69
3L047	20	12				32
3L048	59	10				69
3L049	68	21				89
3L050	175	35				210
3L051	8	5				13
3L052	3					3
3L053	7	7				14
3L054	14	2			2	18
3L055	30	4				34
3L056	15	12				27
3L057	21	16				37
3L058	19	14	1			34
3L059	50	8	5	3		66
3L060	13	3				16
3YE36	42	16				58
3YE37	80	23				103
3YE38	10	11		1		22
3YE39	11	3		2		16
3YE40	136	29	1	2		168
3YE41	263	41	2	1		307
3YE42	4	5	1	1		11
3YE43	15	14				29
3YE44	16	1				17
3YE45	69	18				87
3YE46	1	2	1			4
3YE47	1					1
3YE48	24	6				30
3YE49	11	3				14
3YE50	3	2				5
3YE51	18	15				33
3YE52	19	3				22
TOTALS	1356	402	11	10	2	1791

therefore importing the stone material from which they manufactured cutting tools. Chert and novaculite both produce conchoidal fractures, although novaculite, when properly processed, is the superior raw material in terms of workability and in hardness of the finished product. The material which has been referred to in other studies in the region as argillite is a quartzitic sandstone or orthoquartzite, usually black or gray in color, which produces a conchoidal fracture, but the fracture tends to go around the silica grains instead of through them, giving the surface a granular texture. It is often used for large biface tools such as spades (Hoffman et al., n.d., Bond 1970). One Gary projectile point recovered during this study was made of this material.

The novaculite Uplift subdivision of the Ouachita Mountains, located approximately 25 miles south of Blue Mountain Lake, contains Devonian and Ordovician deposits of limestones, shale, and novaculite. Cherts and quartz crystals, as well as novaculite, occur in this region. This area is the source of novaculite found at Blue Mountain Lake and probably is a source for at least some of the chert.

Other sources of chert are found in the Ozarks, north of Blue Mountain Lake, and in the western Ouachitas. Chert cobbles are found in the Arkansas River and in stream beds along the alluvial valley. This is the most likely source for the majority of the chert recovered from sites at Blue Mountain Lake, although some material appears to be Boone Chert, from the Ozarks, and some is similar to cherts described from the western Ouachitas (Penman 1974). Novaculite cobbles occur along streams that flow southward out of the Ouachitas. No decortication flakes of novaculite were found in the study sample, which would indicate that novaculite cobbles were not being imported to the Blue Mountain Lake locality.

Table 5 shows the ratio of chert to novaculite in the combined categories of debitage (all flake types, shatter, and cores) and bifaces (all bifaces, including projectile points). If novaculite was being imported as finished tool types, as was implied by the lack of novaculite cores in the sample, then this should show up in the table as a small ratio figure among the bifaces and a large ratio figure among the debitage. Unfortunately, this does not show up in the table, even in the larger site collections. Novaculite may have been imported in a semi-refined stage, as large preforms, and worked into final tool shape, or the sample may be overly biased because of the activities of relic collectors. Probably both of these explanations are factors affecting the samples.

Table 5. Ratio of Chert to Novaculite.

Site Number	DEBITAGE Chert	DEBITAGE Novaculite	DEBITAGE Chert: Novaculite	DEBITAGE Total	BIFACES Chert	BIFACES Novaculite	BIFACES Chert: Novaculite	BIFACES Total
3L040	33	6	5.5	39	6	6	1	12
3L041	20	9	2.2	29				
3L042	9	7	1.3	16				
3L043	4	3	1.3	7				
3L044	4	7	.57	11	1		-	1
3L045	4	6	.67	10	3		-	3
3L046	4[illegible]	15	3.1	62	7		-	7
3L047	16	10	1.6	26	4	2	2.0	6
3L048	59	9	6.5	68	3		-	3
3L049	63	20	3.1	83	9	2	4.5	11
3L050	163	33	4.9	196	11	2	5.5	13
3L051	7	5	1.4	12	1		-	1
3L052	2		-	2				
3L053	6	7	.86	13				
3L054	13	2	6.5	15	1		-	1
3L055	24	4	6	28	1		-	1
3L056	4	11	.36	15				
3L057	15	15	1.0	30	3		-	3
3L058	19	10	1.9	29				
3L059	42	8	5.2	50	8		-	8
3L060	10	2	5	12	3	1	3.0	4
3YE36	41	14	2.9	55	1	2	.5	3
3YE37	84	22	3.8	106	3	1	3.0	4
3YE38	9	10	0.9	19	1	1	1	2
3YE39	6	2	3	8	5	1	5.0	6
3YE40	119	23	5.8	142	13	5	2.6	18
3YE41	238	35	6.8	273	25	5	5.0	30
3YE42	4	5	0.8	9				
3YE43	14	12	1.7	26	1	2	.5	3
3YE44	15		-	15	1	1	1.0	2
3YE45	60	16	3.7	76	9	2	4.5	11
3YE46	1	2	0.5	3				
3YE47					1		-	1
3YE48	42	6	4	30				
3YE49	11	3	3.7	14				
3YE50	2	2	1.0	4				
3YE51	18	11	1.6	29		4	-	4
3YE52	17	3	5.7	20	2		-	
Total	1227	355	3.5	1582	123	37	3.3	160

Table 5. Ratio of Chert to Novaculite.

Site Number	DEBITAGE Chert	DEBITAGE Novaculite	DEBITAGE Chert: Novaculite	DEBITAGE Total	BIFACES Chert	BIFACES Novaculite	BIFACES Chert: Novaculite	BIFACES Total
3L040	33	6	5.5	39	6	6	1	12
3L041	20	9	2.2	29				
3L042	9	7	1.3	16				
3L043	4	3	1.3	7				
3L044	4	7	.57	11	1		-	1
3L045	4	6	.67	10	3		-	3
3L046	47	15	3.1	62	7		-	7
3L047	16	10	1.6	26	4	2	2.0	6
3L048	59	9	6.5	68	3		-	3
3L049	63	20	3.1	83	9	2	4.5	11
3L050	163	33	4.9	196	11	2	5.5	13
3L051	7	5	1.4	12	1		-	1
3L052	2		-	2				
3L053	6	7	.86	13				
3L054	13	2	6.5	15	1		-	1
3L055	24	4	6	28	1		-	1
3L056	4	11	.36	15				
3L057	15	15	1.0	30	3		-	3
3L058	19	10	1.9	29				
3L059	42	8	5.2	50	8		-	8
3L060	10	2	5	12	3	1	3.0	4
3YE36	41	14	2.9	55	1	2	.5	3
3YE37	84	22	3.8	106	3	1	3.0	4
3YE38	9	10	0.9	19	1	1	1	2
3YE39	6	2	3	8	5	1	5.0	6
3YE40	119	23	5.8	142	13	5	2.6	18
3YE41	238	35	6.8	273	25	5	5.0	30
3YE42	4	5	0.8	9				
3YE43	14	12	1.7	26	1	2	.5	3
3YE44	15		-	15	1	1	1.0	2
3YE45	60	16	3.7	76	9	2	4.5	11
3YE46	1	2	0.5	3				
3YE47					1		-	1
3YE48	42	6	4	30				
3YE49	11	3	3.7	14				
3YE50	2	2	1.0	4				
3YE51	18	11	1.6	29		4	-	4
3YE52	17	3	5.7	20	2		-	
Total	1227	355	3.5	1582	123	37	3.3	160

EFFECTS OF PROJECT OPERATIONS UPON ARCHEOLOGICAL RESOURCES

The sites located at Blue Mountain Lake have suffered varying effects from the operation of the lake. Not all of these effects can be quantified precisely, but can be estimated from observations made during the fieldwork. For example, erosional impacts occur in several contexts (cf. Padgett 1977), which can only be measured by long term studies. At Blue Mountain Lake, however, it can be estimated that at least 6 inches of soil has been removed from sites located on Pope Silt Loam soils which today have the yellow silty clay subsoil exposed at the surface. This is an apparent impact at sites 3YE37, 3YE38, 3YE43, 3YE45, and probably at sites in Logan County which are located in similar situations (soils survey data could not be obtained for Logan County). The available soils data is not precise enough to make more definite statements on the amount of erosion, but it does give an impression of the extent.

Likewise, it was observed that tree stumps located along the banks of the river in areas of Pope Fine Sandy Loam had soil washed out from under their root systems which in some cases indicated 18 inches or more of soil loss, whereas tree stumps located back from the bank had no noticeable erosion of soil. This indicates that sites 3YE40, 3YE44, 3YE45, 3YE47, and 3YE48 have suffered from bank cutting and/or slumping, but that the major portions of these sites have not been affected by erosion.

Other adverse effects by the lake project can be postulated on circumstantial evidence. Most descriptions of characteristic Fourche Maline sites list the presence of black, organic midden deposits full of shell and bone remains (e.g., Orr 1952, Bell 1953, Wyckoff 1970). The Fourche Maline sites found during the survey, 3YE40, 3YE44, 3YE46, 3YE48, 3LO45, 3LO46, and 3LO50, did not contain any bone, shell, or black earth midden, which raises the suspicion that organic materials have deteriorated and the soil leached as a result of inundation. The upcoming experimental study of inundation effects should determine if this impact does in fact occur at Blue Mountain Lake.

Likewise, the apparent patination on both lithic and ceramic artifacts collected during the survey can be quantified by experimental studies to determine the rate of patination to be expected on different types of material. Patina obscures evidence of edge wear on lithic tools and could obscure decoration on ceramics.

One of the effects of project operations which has little to do with inundation is the uncontrolled, unscientific collecting of artifacts by private individuals. Although this probably occurs to a small degree at sites on the periphery of the lake during normal operations; during the drawdown, and apparently during drawdowns in the past, the lake bed is almost continously scoured by relic hunters seeking to enlarge their private collections.

Collectors were observed during all but two days of the fieldwork portion of this study. Other evidence of previous collector activity at sites recorded in this study included potholes, numerous overturned stones, and "reject piles," piles of flakes that have been picked up, dusted off, carried about for awhile, and then deposited at another place.

Although the drawdown was planned well in advance, public meetings were held to explain the project to local citizens, and signs were constructed at each access area to inform people of the project, no measures were taken to protect the archeological resources from being depleted. This is particularly unfortunate at Blue Mountain Lake since the area was so little known scientifically and was apparently at one time rich in archeological resources.

CONCLUSIONS AND RECOMMENDATIONS

SIGNIFICANCE OF ARCHEOLOGICAL RESOURCES

The 39 archeological sites reported in this study represent a contribution to the knowledge of prehistory in this portion of Arkansas. Although some of the sites are represented by very small surface collections, all indicate the locus of some form of human activity in the past. Most of the sites represent portions of small villages or base camps which were established on the banks of the Petit Jean River. The available information from other surveys in the northern Ouachitas and the Arkansas Valley indicate that the major river valleys were intensively settled while the upland areas were relatively unused except for procurement activities. With the gathering and analysis of additional data in the form of chronological control, subsistence data, and paleoenvironmental reconstruction, the patterns of prehistoric settlement could be put in regional perspective and a number of specific problems could be examined.

Unfortunately, it is doubtful that additional study of any of the sites at Blue Mountain Lake, with the possible exception of 3LO59, would yield any significant amount of new data. Depletion of the cultural material through apparent erosion, deterioration, and relic hunting has lessened the research potential of all the sites located below the normal lake level.

Of course, had this survey been conducted 35 years ago, a good deal of information might have been obtained from excavations and surface collections. Now, the combined effects of inundation and uncontrolled collecting, not to mention the construction activities associated with the dam building, have served to severely limit the scientific value of the archeological resources at Blue Mountain Lake. This survey has served to document, to some degree, what was there. In that respect the study was successful. Further work, except as noted above, is unlikely to produce enough new data to make it worthwhile.

RECOMMENDATIONS

Additional work at archeological sites located below the conservation pool level of Blue Mountain Lake is not recommended. Test excavations at site 3LO59 could provide the necessary data to establish that site's significance and eligibility for inclusion to the National Register of Historic Places, but these tests would probably necessitate clearing of at least portions of the site and that would make the site more vulnerable to shoreline erosion and vandalism. Therefore these tests should be carried out only if the site is threatened with destruction.

It is recommended that the experimental study of inundation effects (Appendix A) be carried out at Blue Mountain Lake with cooperation from the Corps of Engineers to insure that the experimental site is not disturbed by vandals or visitors to the lake. This study will aid in evaluating the nature and degree of impact that fresh water immersion has had and will have on archeological resources at Blue Mountain Lake and other fresh water lakes and reservoirs.

It is also recommended that future drawdowns at other Corps of Engineers lakes be planned to accommodate archeological studies in the early phases of the project. If archeologists are notified in the early planning stages, a study could be designed to involve the public by using avocational archeologists under professional guidance to conduct archeological investigations. This would alleviate uncontrolled relic collecting and serve to protect archeological and historic resources under the jurisdiction of the federal government. The public's growing interest in the past can then be channeled into constructive activities which contribute to scientific understanding of a nonrenewable resource--our heritage.

PART II

AN EXPERIMENTAL STUDY OF INUNDATION IMPACTS UPON ARCHEOLOGICAL SITES

This study was conducted under a Cooperative Agreement between the National Park Service, Southwest Cultural Resources Center and the Arkansas Archeological Survey and funded under Purchase Order Number PX 7029-7-0901 and PX 7029-8-0016.

MANAGEMENT SUMMARY

GOALS OF THE PROJECT

The Blue Mountain Lake Inundation Study was designed to provide tests for various hypotheses concerning the impacts of inundation upon archeological and historical resources. The project involved construction of experimental archeological features at an area of Blue Mountain Lake which is normally under water. The project incorporated preinundation analyses of materials placed in the experimental site, as a basis for postinundation studies.

This report describes the procedures followed in setting up the experiments and analytical tests, and the results of the preinundation analyses. The project was funded through a cooperative agreement between the National Park Service, Southwest Cultural Resource Center, and the Arkansas Archeological Survey (PX 7029-7-0901, PX 7029-8-0016).

RESULTS OF THE STUDY

All of the projected tests were carried out as proposed, with the exception of the archeomagnetic and alpha-recoil track dating experiments. The alpha-recoil track samples may be included in the project at a later date, while the experimental site is inundated. The actual results of the overall experiment will not be known until the site is investigated after a period of inundation. The project is designed so that a series of observations can be obtained over an indefinite time span.

SIGNIFICANCE OF THE STUDY

Care was taken to conform to the general research design presented by the Reservoir Inundation Studies Project in order that results from the Blue Mountain Lake study will be compatible with the studies being conducted in other parts of the country under that program. The aims of the Reservoir Inundation Studies Project are to determine what impacts upon archeological sites can be predicted when those sites are inundated by reservoir projects, which archeological data classes can be expected to survive reservoir inundation under specific sets of conditions, and what measures can be taken to mitigate adverse impacts upon the cultural resources subjected to reservoir inundation. The results of this program should not only be of interest to managers who must make decisions about the disposition of cultural resources affected by reservoir construction projects, but should also provide an appraisal of the research potential of known archeological and historical sites which have been inundated for many years.

RECOMMENDATIONS

The experimental site should be revisited within two years and inspected while it is inundated. Samples can be recovered at that time for analysis, but a portion of the site should be left intact for future investigations when the lake is drawn down. Ideally, the site could be reinvestigated at intervals for a larger period of time and rates of deterioration of the archeological features and materials could be established with accuracy.

INTRODUCTION

PROJECT BACKGROUND

When Blue Mountain Lake was drawn down during the summer of 1977, the Little Rock District of the Army Corps of Engineers contracted with the Arkansas Archeological Survey to survey the exposed lake bottom and make an assessment of the cultural resources found there. Before the fieldwork for that project was begun, the National Park Service was contacted about the possibility of incorporating studies at Blue Mountain Lake in the Reservoir Inundation Studies Project. The situation at Blue Mountain Lake presented several assets for studies of the effects of inundation on archeological resources: 1) the lake is relatively shallow, less than 4 m deep in most sections, 2) there was easy access to the exposed lake bottom during the drawdown, and 3) the lake is drawn down periodically to improve water conditions, which will allow monitoring at 7 to 10 year intervals.

The survey of the exposed lake bottom resulted in the recording of 39 historic and prehistoric period archeological sites (Padgett 1977a). Physical disturbance, apparently due to inundation, was noted at most of these sites. Similar apparent disturbance of archeological materials has been reported at Dierks Lake (Padgett 1976b), Bull Shoals Lake (Cantley and Novick n.d.) and Norfork Lake (Padgett 1977) in Arkansas, and in many reservoirs in other states (see Carrell et al. 1976). The problem with documenting adverse (or beneficial) impacts of reservoir inundation has always been in quantifying the results. Even when some data is available from preinundation studies, it is difficult to obtain comparable data from which measurements of impacts can be made.

DESCRIPTION OF THE PROJECT

The proposal submitted to the National Park Service (Appendix A) outlined an experimental study designed to test a number of hypotheses about the various impacts of inundation on archeological materials. An experimental framework was decided upon in order to increase control over the many variables which come into play when archeological sites are submerged. This involved simulating archeological contexts for the various materials and features being tested rather than attempting to carry out tests at an actual prehistoric and/or historic site.

The project was conducted in three phases. During the first phase, a project specific research design was developed and the test samples were collected, cataloged, and prepared for placement in the experimental site. The second phase consisted of the fieldwork, and the third phase involved carrying out the analyses of comparative samples from control groups and preparation of the final report. Due to the complexities of funding the project, the proposal was prepared in two parts: the basic study and a supplemental study expanding the scope of the project by including several more tests. Both parts of the study were funded under a cost sharing agreement between the Arkansas Archeological Survey and the National Park Service (Appendix A).

EXPERIMENTAL ARCHEOLOGY

Experimental archeology has proven to be an extremely useful approach in the interpretation of archeological data. From Tyler's experiments on the efficiency of skin-scrapers (Lowie 1937:68) to Ahler's (1970) analysis of projectile points, it has usually taken the form of imitative experiments of tool function, especially lithic tools. Ascher (1961) reaffirmed the potential of experimental archeology, but dealt only with imitative experiments of various types. More recently, archeologists have been exploring ways in which experimental archeology can contribute to formation of theoretical models of behavior (cf. Saraydar and Shimada 1973, Ingersol et al. n.d.).

The Blue Mountain Lake study is simulative rather than imitative in nature. The focus of the experiment is not the function of particular features or artifacts, but the effects of a particular environment (fresh water immersion) upon features and artifacts. The study is similar to experiments which have been set up to test natural actions on archeological sites in a noninundated context. The most ambitious project of this nature is the Overton Down Earthwork (Jewell 1963), a 100 year project being conducted by the British Association for the Advancement of Science. Other experiments, on a smaller scale, have been undertaken in Europe (Coles 1973) and North America (Ascher 1970). Since all of these are longevity studies, including the Blue Mountain Lake project, results await future reinvestigation.

SETTING OF THE STUDY

Blue Mountain Lake is located in west-central Arkansas, between the towns of Booneville and Danville on the northern edge of the Ouachita Mountains (see Part I, pp. 4-8). A site for the experimental study was selected near the eastern end of the lake (Fig. 1) where proximity to the Corps of Engineers' Project Superintendent and Dam Operator's Office would facilitate the security arrangements.

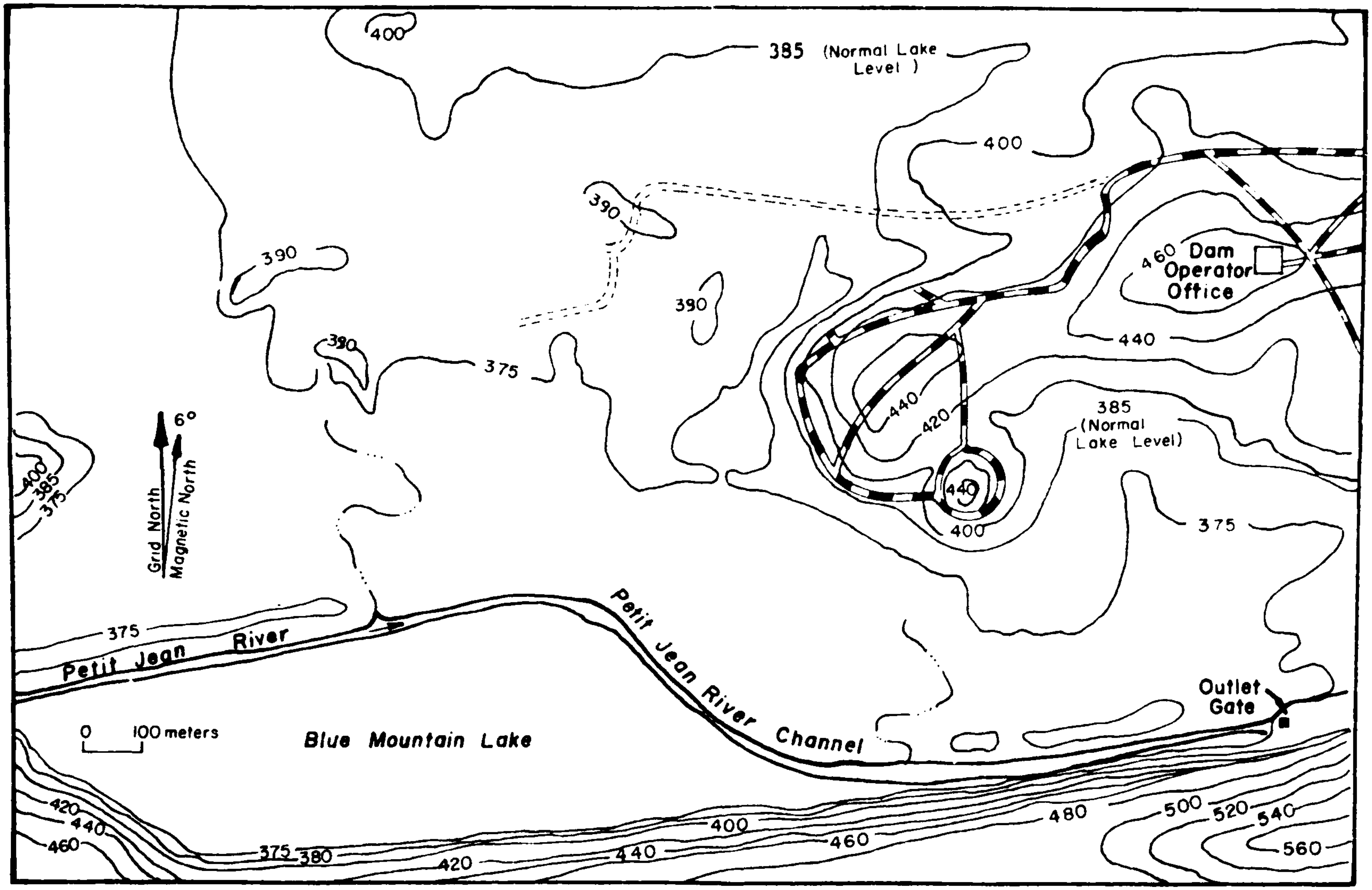

Figure 1. Topographic map of eastern end of Blue Mountain Lake (Waveland Park area).

PROJECT RESEARCH DESIGN

INTRODUCTION

The Blue Mountain Lake Inundation Study is an experiment designed to test certain affects of fresh water immersion upon archeological sites and upon materials commonly found in archeological sites. The research design for this project is derived directly from the preliminary report compiled by the National Park Service Inundation Studies Team (Lenihan 1977). All of the hypotheses listed below, with the exception of D-2, are taken directly from that report, as are the test implications. However, only the test implications pertinent to the experiments being conducted are included. The procedures, measurements, samples, etc. are specific to this particular project and detail the methods used to set up these tests. All of the experiments listed below involve pre- and postinundation comparisons, so no results will be known until the experimental site is reinvestigated after a period of inundation. Whenever possible, the tests have been set up to allow "matched pairs" comparisons between different types of materials in the inundation site (the experimental site) or between inundated materials and noninundated control groups. Matched pairs will allow strong statistical tests of the results.

Equal weight has not been given to each test. The test involving ferrous metals, for instance, consists of one sample, while tests involving the deterioration of ceramics and stone use much larger samples and rigorous measurements. The formation of ferric oxide on iron objects is a well understood process while the variables involved in deterioration of earthenware and chert are, if not more complex, at least less known.

An attempt has been made to keep the experimental inundation site fairly realistic in terms of the materials and features used. With a few obvious exceptions such as obsidian and some southwestern ceramics, all of the materials used are similar to materials that have been recovered from actual archeological sites in Blue Mountain Lake or other areas in Arkansas.

Variables such as water temperature and chemical composition and water level fluctuations can be expected to affect several of these tests. Fortunately, the Army Corps of Engineers keeps accurate records of these variables and they will be available for examination and evaluation when the results of these tests are being compiled.

Some of the materials being tested may not show any evident changes by 1980 and should be examined during the next drawdown of the lake (approximately 1985) and monitored for a longer period. Many of the tests, however, should yield results before the end of the NPS Inundation Study program.

INUNDATION STUDY EXPERIMENTAL TESTS

A. Differential Preservation of Archeological Materials

Test 1. Ceramics

a) Hypothesis: The basic ceramic structure of ware from an inundated context will be adversely affected by water saturation in a ratio proportional to its porosity, permeability, and strength.

Test Implications:
1) Ceramic samples of low porosity and permeability and high strength (that is, stable) taken from an inundated context will be in a state of preservation comparable to ceramic samples of similar nature taken from noninundated contexts.
2) Ceramic samples of high porosity and permeability and low strength (that is, unstable) taken from an inundation context will not be in a state of preservation comparable to ceramic samples of a similar nature taken from noninundation context.

Measurements Necessary: (from Shepard 1956:125-136)
1) Porosity

$$P = \frac{sf-wf}{Vf} \times 100$$

where P = percent apparent porosity
sf = weight of saturated test piece in gm.
wf = weight of dry test piece in gm.
Vf = volume of test piece in cm^3

2) Strength

$$M = \frac{3Pl}{2bd^2}$$

where M = modulus rupture in kg/cm^2
P = breaking load in kg.
l = distance between supports in cm.
b = breadth of bar in cm.
d = depth of bar in cm.

Procedure: From a homogeneous lot of 100 sherds, isolate 50 to be placed in inundation site as a group, of the 50 remaining select 25 for control group to go to museum storage and cut the remaining 25 into standard bar size (2:1 ratio length to width) and measure tensile strength. This test requires breaking the test pieces in half, and one half of each piece will be measured for porosity and then placed in storage while the other half of each piece will be placed in the inundation site. Total of control group in storage will be 50 (25 whole sherds, 25 tested sherds) and the total of the test group placed in the inundation site will be 75 (50 whole sherds, 25 tested sherds). Repeat process for second group of homogeneous sherds of different temper. Matched pair test comparisons should be carried out after recovery.

Archeological Significance: Factors being tested are based upon behavioral patterns in the manufacture of ceramics which are often culturally distinctive (i.e., selection of temper, manufacture technique, firing methods). If the hypothesis is true, certain types of ceramic ware will survive in inundated contexts while other types may deteriorate, thus altering or disturbing the archeological record.

Samples Required: Varieties of prehistoric ceramic wares: Neeley's Ferry Plain (shell tempered), Coles Creek Plain (grit tempered).

Sample Specimen Numbers: A-1a-77-1-0,1,2,...25;
A-1a-77-2-0,1,2,...25

b) Hypothesis: Fugitive painted decoration on stable ceramic ware from an inundated context will be dissolved by water saturation, and will therefore not be in a state of preservation comparable to fugitive painted decoration from a noninundated context.

Test Implications:

1) Fugitive painted decoration of ceramic samples from an inundated context will not be in a state of preservation comparable to a like number of similar samples from a noninundated context.

2) Nonfugitive painted decoration of ceramic samples from an inundated context will be in a state of preservation comparable to a like number of similar samples from a noninundated context.

Measurements Necessary: None

Procedure: Matched pairs tests conducted by cutting individual ceramic sherds of each type in half, labeling each half, placing one half in inundation site and the other half in museum storage. This will allow side by side comparison after recovery.

Archeological Significance: Decorative technique is often often a major variable in classification of prehistoric ceramics by archeologists. If the hypothesis is true, fugitive painted ceramics recovered from an inundated site may be classified incorrectly, thus distorting the archeological record.

Samples Required: Varieties of ceramic ware: Larto Red Filmed, Varney Red Filmed, Pueblo Black on White (several varieties)

Sample Specimen Numbers: A-1b-77-1-1,2,...
A-1b-77-2-1,2,...

Test 2. Stone

Hypothesis: The differential preservation of inundated stone artifacts will be dependent upon the chemical composition of the artifact in question. Destruction of the artifact will increase with the quantity and distribution of impurities and the relative amounts of feldspar, silica, and carbonates contained within the specimen and the nature of inundation, i.e., periodic or continuous, to which it is subjected. Preservation and destruction will also depend upon the pH of the water and soil within which the stone is located. Increased amounts of acid in solution will directly affect the rate of mineral dissolution and the loss of structural integrity of the stone specimen.

Test Implications:

1) Stone artifacts which have a high ratio of carbonate minerals and readily water soluble or unstable impurities or other minerals and which are exposed to continuous inundation will deteriorate at a faster rate than artifacts which have a low rate of carbonate minerals and readily water soluble or unstable impurities to other minerals and which are exposed to continuous inundation.

2) Stone artifacts which have a high ratio of silica and a low proportion of water soluble or unstable impurities to other minerals and which are exposed to continuous inundation will deteriorate at a slower

rate than stone artifacts which have a low ratio of silica and/or high proportion of water soluble minerals and unstable impurities and which are exposed to continuous inundation.

Measurements Necessary: Weight;
Specific gravity ($\frac{W_1}{W_1-W_2}$)

Procedure: From homogeneous lot of 100 chert or novaculite flakes select 50 by blind selection process for placement in inundation site. Materials used will be Peoria chert, Boone chert, and Arkansas novaculite. All material will be selected from recently chipped material with little patination (secondary decortication and interior flakes) present on specimens. Boone and Peoria cherts have high carbonate mineral composition and Arkansas novaculite has a high silica composition (Walt Manger, personal communication). Make measurements of weight and specific gravity on sample of 10 from each lithic group and weigh each lot of 50 specimens. Inundation samples may be placed in nylon or plastic mesh bags and placed at a shallow depth below the surface of the inundation site to facilitate recovery.

Archeological Significance: Chipped stone materials are found in most prehistoric sites in the eastern U.S., and make up the bulk of the archeological materials at certain kinds of sites. Functional analysis of lithic materials often involves observation of wear patterns and measurements of such attributes as specimen weight and edge angles. Deterioration of lithic material can adversely effect the results of these analyses.

Samples Required: Homogeneous lots of 100 flakes each of Peoria chert, Boone chert, and Arkansas novaculite. This material is from known proveniences and is the byproduct of lithic replication studies conducted in 1976-77. Therefore all samples have freshly exposed surfaces, although a small amount of cortex may be present on some flakes.

Test 3. Bone

Hypothesis: Osteological remains subjected to reservoir inundations will receive differential preservation, depending upon the condition of the specimens at the time of inundation, and upon the nature of the new environment. Osteological materials that are subjected to such mechanical forces as currents, erosion, and slumpage, or with a pH change toward acidity (pH value below 7.0) will not be well preserved following inundation.

Test Implications:

1) In an inundated context, those materials that have the greatest surface area and porosity or those that are poorly preserved will be more susceptible to destruction resulting from pressure and waterlogging than those that are dense and impervious.
2) In an inundated context, dense and impervious materials are less susceptible to crushing and waterlogging, and therefore will be more suitable for identification and analysis after inundation than less dense and more porous materials.
3) In an inundated context, where chemical changes have altered the pH or introduced bacterial activity, or where mechanical activity has disturbed the soil matrix, loss of osteological materials will result.
4) In an inundated context, chemical changes in osteological materials will occur as a result of loss of soluble trace elements.

Measurements: Metric data, trace element analysis

Procedure: Osteological material is sorted into two groups for each animal species represented. One group is composed of cranial and rib bones and the other group is composed of long bones, mandibles, and teeth (denser less porous bones). One half of each group is then to be placed in the inundation site while the other half of each group is placed in museum storage with no chemical preservation. Material placed in the inundation site will be at uniform derth (10 cm below surface). Samples of each group are to be subjected to trace element analysis.

Archeological Significance: Both human and nonhuman osteological materials are often found in archeological sites. Data derived from these materials is extremely important in the interpretation of archeological sites and several subdisciplines (e.g., zooarcheology, paleopathology, bioarcheology) concerned with the analysis of osteological materials have been developed. Total or selective loss of osteological materials will adversely effect these analyses.

Samples Required: Osteological materials representing different animal species, including *Homo sapiens*. All material must be free from chemical preservatives.

Sample Specimen Numbers: A-3a-77-1,2

Test 4. Ferrous Metals

Hypothesis: Ferrous compound (iron) corrosion will accelerate with fresh water site inundation in most reservoir situations. This condition will vary, depending on specific reservoir conditions (depth, water salinity, water currents, bacteria types, and water turnover).

Test Implications:

1) In an aerobic reservoir situation with low salinity, varying water temperature and little current, the ferric-oxide scale formed will spall off, starting another round of ferric-oxide scale formation and eventual loss of artifact.

Measurements Necessary: Metric data.

Procedure: Using chemical (phosphoric acid) and mechanical cleaning methods, clean all ferric oxide scale (rust) from half the length of an iron artifact recovered from a noninundated context leaving the other half uncleaned. Paint half of the exposed portion of the artifact with a corrosive inhibitor, then bury entire artifact in the inundation site, for postinundation recovery.

Archeological Significance: Although ferrous objects will deteriorate in most noninundation contexts, inundation may accelerate the deterioration, thus inhibiting the analysis of historic period sites which exhibit these kinds of artifacts.

Samples Required: One iron artifact (section of bedframe or angle iron) recovered from a pre-1940s historic period component.

Sample Specimen Number: A-4-77-1

Test 5. Shell

Hypothesis: Inundation will accelerate the rate of deterioration of shell, so that samples from an inundated context will not be in a state of preservation comparable to samples from a noninundated context.

Test Implications: Shell samples taken from an inundated context will consistently be in a poorer state of preservation than samples of a similar age taken from a noninundated context.

Measurements Necessary: Weight

Procedure: With recently collected specimens of fresh water mussel shells, place 80% of the number of sample specimens in the inundation site, below the surface, and retain the other 20% in museum storage.

Archeological Significance: Shell is found in many archeological sites, both as artifacts (culturally modified) and as food residue. Quantification of mussel shell varieties can be used in reconstructing environmental as well as subsistence patterns. Loss or deterioration of shell hinders those types of analysis.

Samples Required: Fresh water mussel shells of known genus

Sample Specimen Number: A-5-77-1

B. Impact Upon Analytical Techniques

Test 1. Soil Chemistry Analysis

Hypothesis:
1) At a specific site, absolute pH values will be altered by the effects of inundation, but should still yield relative pH values that are useful in archeological research. In a loosely compacted soil stratum pH values will approach the reservoir pH value, if this loose stratum does not lie below a compact soil stratum.
2) The potential for soil nitrate analysis will be lost in direct proportion to the length of time immersed.

3) Inundation will wash out potassium salts from the upper strata of a site, but should not affect the potential analysis of potassium values below those levels saturated by water.

Test Implications:

1) A series of soil samples taken from the same soil stratum within a site after inundation will yield different pH values than comparative samples taken prior to inundation.

2) A series of soil samples taken from different soil units within a site after inundation will yield different pH values from the same series taken prior to inundation, but will approximate the relative differences in pH values between the soil units.

3) Taken after inundation, pH samples from loosely compacted soil strata will yield absolute values that approximate those of the reservoir pH values at that location.

4) A series of soil samples taken from all soil strata of a site after inundation will yield greatly diminished or undetectable values for nitrates, compared to a series taken prior to inundation.

5) Soil samples of the upper levels of a site taken after inundation should yield different potassium values than samples taken prior to inundation, but will still be usable for relative potassium value interpretations.

6) A series of soil samples taken from subsurface features after inundation will contain the same percentage of organic matter as comparative samples taken prior to inundation.

7) A series of soil samples taken from surface features after inundation will contain a different percentage of organic matter than comparative samples taken prior to inundation.

Measurements Necessary: Soil chemical analysis (pH, phosphate, nitrate, potassium, and trace element analysis).

Procedure: Take soil samples from various contexts in the inundation site, including samples from introduced soils that are used in soil strata impact tests.

Archeological Significance: Soil analysis is used in archeolog cal studies to aid in interpretation of intrasite variability and function, since behavioral activities often result in modification of natural soil chemistry.

Samples Required: Soil samples as indicated.

Sample Specimen Numbers: None

Test 2. Flotation

Hypothesis: The results obtained from flotation samples removed prior to and following inundation will vary according to localized soil conditions and mechanical impacts to which the sample is subjected. Flotation samples situated in a loosely consolidated soil matrix will not yield comparable pre-and postinundation results.

Test implications:
1) In an inundated context, flotation samples situated in loosely consolidated sediments will be subject to natural flotation, and will therefore not yield comparable pre- and postinundation results.
2) In an inundated context, flotation samples situated in fine grained soils such as silt or clay are less apt to be disturbed by natural flotation and redistribution, and will therefore yield comparable pre- and postinundation results.

Measurements Necessary: Gram weights of samples.

Procedure: Partially carbonize samples of plant seeds and nut fragments by roasting. Divide each individual sample in half (by weight) to create two test units in the inundation site. One unit will consist of the carbonized seed and nut fragments mixed in loose sand matrix; the other will consist of an equal amount (by weight) of the carbonized samples mixed in a silt-clay matrix compacted with a hard clay cap over the unit. Both units should be of the same dimensions and depth.

Archeological Significance: Flotation is the most frequently used method of extracting macrobotanical remains (and other materials which are not easily recovered through matrix screening techniques) from archeological deposits. Data recovered from flotation techniques are used in reconstructing diet, environment, and other factors. All plant remains used as specimens for this test are of varieties that have been recovered from archeological sites in Arkansas (Cutler and Blake 1973:9-12). Modern dent corn is substituted for maize varieties utilized by prehistoric Indians. Since plant remains in a carbonized state are often found preserved in archeological sites, portions of samples used in this study are carbonized.

Samples Required: Walnuts (*Juglans nigra*), Hickory nuts (*Carya sp.*), Acorns (*Quercus sp.*), Amaranth (*Amaranthus retroflexus*), lambsquarters (*Chenopodium alba*), Peach pits (*Prunus persica*), Corn (*Maiz sp.*)

Sample Specimen Numbers: None

Test 3. Impact Upon Standard Survey Techniques

Hypothesis: The capability of standard survey procedures for survey or resurvey of archeological sites following inundation will depend largely upon the nature of the site and the impact of the reservoir variables on the site. Standard archeological survey procedures conducted to locate archeological sites following inundation will not yield comparable pre- and post-inundation results. This will be most evident in sites that are either buried beneath silt or greatly disturbed by mechanical activity.

Test Implications:

1) Following inundation, archeological sites that are not covered with silt, but have been subjected to shore erosion or other mechanical activity, will not yield comparable survey results in terms of structural integrity or artifact distribution.

Measurements Necessary: Weight and number of specimens

Procedure: Place numbered samples of lithic and ceramic artifacts on the ground surface within a 2 m square unit at the inundation site. The 2 m square unit will be divided into 4 one meter quadrants and a different type of material will be placed in each quadrant, evenly spaced within the quadrant.

Archeological Significance: The patterning of artifacts on the surface of an archeological site is usually noted during standard archeological surveys, either implicitly through the observations of the survey archeologist, or explicitly through measurements of artifact density such as are made in controlled collections. Patterning of surface materials is often used as an indication of subsurface features and/or as indicator of site function and intrasite functional variability. Distortion of surface artifact patterns through mechanical actions will affect the interpretation of the site as well as make site relocation difficult.

Sample Required: Lithic materials of difference sizes and lithic types, ceramics

Sample Specimen Numbers: a) ceramics, B-3a-77-1,2
c) lithics, B-3b-77-1,2

C. Impact Upon Dating Techniques

Test 1. Archeomagnetic Dating

Hypothesis: Archeomagnetic samples removed from reservoir contexts will not exhibit adverse effects from inundation, except when exposed to periodic drawdown conditions.

Test Implications:
1) In an inundated context, undisturbed specimens not adversely affected by erosion will yield comparable pre- and postinundation results.
2) In an inundated context, specimens disturbed by direct or indirect mechanical impacts or by internal expansion and contraction, such as may occur during periods of drawdown, will not yield reliable results.

Procedure: At the inundation site, prepare two clay hearths, one at a depth of 50 cm or more below the normal ground surface and one at a depth of less than 10 cm below normal ground surface. Allow clay to dry sufficiently and fire the hearths by creating an open fire in each and sustaining temperature until sufficient firing has taken place. Orient the hearths to magnetic north and remove samples from each to be compared with samples taken after inundation.

Archeological Significance: Archeomagnetism is a relatively new technique which has been successful in dating archeological features. The technique, however, is only useful if the sample is oriented to magnetic north while *in situ* and if the feature has not been disoriented since the time of original firing. Any movement of the feature will cause a distorted dating result.

Sample Required: Archeomagnetic samples taken soon after firing of the hearth feature.

Sample Specimen Numbers: None

Test 2. Alpha Recoil Track Dating

Hypothesis: Samples taken for fission track and alpha recoil dating purposes will not be skewed due to the effects of inundation.

Test Implications: Comparative samples of the same age, as determined by established archeological controls taken for fission track and alpha recoil dating purposes in all reservoir situations will yield similar results.

Procedure: From a provenience lot of ceramic sherds which has furnished successful alpha track samples place a sample of unanalyzed sherds in the inundation site for recovery and postinundation analysis.

Archeological Significance: Alpha recoil track dating techniques, although currently still in the experimental stage of development, may someday become an efficient and accurate means of dating certain kinds of archeological materials. At least one study has already been conducted that indicates that the hypothesis stated above is not true in all cases (Wolfman and Rolniak 1977).

Samples Required: Ceramics which have been tested for alpha recoil tracks.

Sample Specimen Numbers: None

Test 3. Obsidian-Hydration Dating

Hypothesis: The rate of hydration of obsidian will be altered when subjected to the environmental changes that accompany the inundation of archeological sites, and analysis of the hydrated face will yield dates that will not be comparable to samples of similar composition from a noninundated context.

Test Implications:

1) Obsidian that is superficially exposed, or buried at a depth less than 50 cm will exhibit a differential rate of hydration when subjected to inundation; and analysis of the hydrated face will yield a date that is not comparable to obsidian of similar chemical composition, depth of burial, and length of exposure, that has not been inundated.

Procedure: Place samples of obsidian (different varieties) in the inundation site so that one sample group is buried at a depth of less than 50 cm and one sample group is buried below 50 cm. Place samples of similar material at similar depths of burial in a unit near the inundation site but above the level of water immersion.

Archeological Significance: Obsidian hydration has been used as a dating technique since the early 1960s but the rate of hydration can be affected by many factors. If the variables introduced by fresh water immersion can be measured, then this technique may still be usable in analysis of inundated materials.

Samples Required: Specimens of obsidian (two varieties) of known source, with freshly exposed faces.

Sample Specimen Numbers: C-3-77-1; C-3-77-2

D. Impact Upon Archeological Features (Natural and Cultural)

Test 1. Soil Strata Data

Hypothesis: Soil silhouettes (profiles) will, in certain soil types, be affected by inundation. Soil stains will be more affected than soil textures. The depth below the land surface will affect soil profiles with relationship to the degree of soil saturation. At sites that are alternately wet and dry, soil stains will be more affected than at sites that are constantly inundated.

Test Implications:

1) A soil profile consisting of both color and textual qualities in compact soils (clays, silt,

silty clays) will maintain interpretive integrity. 2) A soil profile consisting of both color and textual qualities in loose soil (sand, sandy loam) on a constantly inundated site will maintain interpretive integrity.

Procedure: At the inundation site, create two soil profiles using soils of different types, both local and from other sources, to simulate natural and cultural stratigraphy. The two soil profiles should be oriented at right angles (perpendicular to each other). Place plexiglass over the exposed profiles and mark (with scribe and indelible marker) the soil strata on the plexiglass. Backfill trenches facing the profiles (see also test D-2).

Archeological Significance: Soil stratigraphy is an integral part of archeological site interpretation. The preservation of both cultural and natural strata in an archeological site can be a vital factor in determining chronology, features, and other data.

Samples Required: Soil samples to be analyzed (re: B-1). Cultural materials (sherds, lithics) to be used with black organic soil to simulate midden layer.

Sample Specimen Numbers: D-1-77-1; D-1-77-2

Test 2. Cultural Features

Hypothesis: Cultural materials and organic matter will be better preserved when located in relationship to a cultural feature that acts as a barrier to water saturation than cultural materials and organic matter that are not located in such a relationship to a cultural feature.

Test Implications: Archeological materials located beneath clay floors or hearths or within inverted ceramic vessels within an inundated site will be in a state of preservation comparable to similar materials from a noninundated context, and will be in a better state of preservation than similar materials from an unprotected inundated context.

Procedure: Within the artificial soil profiles created for Test D-1 place some ceramic, lithic, and osteological materials below a layer of compacted clay. In another unit of the inundation site, place similar materials in a pit and cover the pit with a layer of clay, let dry, then bake the clay by building a fire on its surface. In another unit, place a sample of nuts and seeds in a ceramic jar (earthenware, shell tempered) and invert the jar. Cover all units with soil.

Archeological Significance: In many archeological sites evidence of previous occupations of the site is located beneath cultural features of later occupations. Ceramic vessels and lined storage pits containing plant remains such as seeds and nuts are also commonly found in archeological sites and constitute important sources of subsistence data.

Samples Required: Ceramic sherds, lithics, bone, nuts, and seeds. Whole ceramic vessel (replica of Middle Mississippian jar).

Sample Specimen Numbers: D-2-77-1,2. Materials used in soil profiles will be cataloged with numbers of that test--D-1-77-1,2.

LABORATORY PROCEDURES

CATALOGING SYSTEM

All inorganic material, and some organic material such as shell and bone, was assigned a catalog number. The catalog system devised for this experiment was based upon the research design outline. The system consists of a letter designation denoting the category of tests, a number indicating which particular test under that category the sample is used for, a year designation (77) indicating year of the study, and a number to indicate sample lots. To this may be added a sequential number to indicate individual pieces. Therefore, a specimen labeled C-3-77-1 pertains to category C of the research design-- Impact upon Dating methods; test 3 - Obsidian Hydration Dating; sample lot 1. Likewise, number A-1a-77-2-16 refers to the 16th grit tempered sherd used in the tests of differential preservation of ceramics. The catalog numbers of the Zebree materials were not changed to conform to this system since that material was not anticipated in the research design. Specimens were cataloged using permanent black carbon-based ink. A varnish fixative was used over numbers on samples with nonporous surfaces. The catalog list is included in Appendix B.

PHOTOGRAPHY AND OTHER RECORDS

Black and white photographs and color slides of materials used in the experimental site were taken before the material left the lab. The photographic records also include some scenes showing laboratory procedures. These photographic records, along with the field photographic records, are an integral part of the experimental study and form a basis for postinundation comparisons. The record forms are included in this report as Appendix C and copies of prints and slides will be presented to the Reservoir Inundation Studies Project team. Other records to be submitted separately are copies of the laboratory notes, the fieldnotes, and site maps.

FLORAL SAMPLES

Nuts and seeds are most often found in archeological sites when they have been partially or completely carbonized. Portions of all floral samples, except the acorns and peach pits and the corn and squash placed in ceramic vessels, were charred before being weighed and placed in the experimental site. The corn and squash samples were obtained from a local supermarket while the other floral samples were collected on field trips in Washington and Marion Counties, Arkansas.

LITHIC SAMPLES

Lithics used in the experiment are the byproducts of tool replication studies conducted by Micky Sierzchula at the University of Arkansas. Four types of stone were used: Arkansas novaculite (black and white varieties), Peoria chert, Boone chert, and obsidian (black and mahogany varieties). Boone and Peoria cherts are very similar stone types, with minor morphological differences. Novaculite is a metamorphosed chert which, although it grades considerably in its distribution, can be distinguished from chert both subjectively and through instrumentation (cf. Keller et al 1977). In order to distinguish changes in structural integrity of chert and novaculite the specific gravity of a sample of flakes of each was calculated. The results of these measurements are listed in Table 1.

Table 1. Specific gravity of lithic samples

	Highest	Lowest	Range	Median	Mean	Variance
Boone chert (n = 10)	2.835	2.498	0.337	2.656	2.649	0.064
Novaculite (n = 10)	3.119	2.711	0.408	2.914	2.914	1.829
Peoria chert (n = 10)	2.707	2.467	0.240	2.618	2.594	0.049
Obsidian (n = 10)	2.764	2.365	0.399	2.555	2.565	0.108

CERAMICS

Ceramics used in the experiments were obtained from the University of Arkansas Museum, except in the case of the large ceramic jar which was a replica. The ceramic analysis for the experiments on deterioration required tests of strength and porosity of samples from two lots of pottery--one grit tempered and one shell tempered. Strength and porosity are the major determinants of ceramic durability according to Shepard and the analytical techniques used are those outlined by her (Shepard 1956:125-136). The apparatus used to test the strength of sherds (cut to standard size - 1.5 x 3 cm) measured the force necessary to break the sherd in terms of movement of the breaking bar. This was converted by linear equation to pounds of pressure, which was then converted to kilograms for the calculations deriving the modulus of rupture. The results are listed in Table 2.

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Table 2. Strength test for ceramics - shell and grit tempered

Grit temper			Shell Temper		
Catalog Number	Pressure (kg)	M (kg/cm^2)	Catalog Number	Pressure (kg)	M (kg/cm^2)
A-la-77-1-1	1.361	1.349	A-la-77-2-1	5.715	8.467
A-la-77-1-2	2.359	3.136	A-la-77-2-2	1.778	7.052
A-la-77-1-3	1.814	2.687	A-la-77-2-3	5.044	6.053
A-la-77-1-4	2.286	4.286	A-la-77-2-4	2.268	4.838
A-la-77-1-5	4.391	7.293	A-la-77-2-5	7.221	11.992
A-la-77-1-6	2.261	5.537	A-la-77-2-6	0.979	4.703
A-la-77-1-7	3.792	7.110	A-la-77-2-7	2.359	5.777
A-la-77-1-8	3.429	6.429	A-la-77-2-8	3.810	5.644
A-la-77-1-9	4.022	11.423	A-la-77-2-9	1.633	5.443
A-la-77-1-10	2.794	6.842	A-la-77-2-10	4.246	6.290
A-la-77-1-11	3.175	4.704	A-la-77-2-11	2.449	8.163
A-la-77-1-12	3.701	4.921	A-la-77-2-12	2.812	6.887
A-la-77-1-13	2.359	10.512	A-la-77-2-13	1.724	6.839
A-la-77-1-14	5.443	6.532	A-la-77-2-14	5.117	5.569
A-la-77-1-15	5.915	9.824	A-la-77-2-15	2.576	10.218
A-la-77-1-16	4.518	7.504	A-la-77-2-16	2.431	4.559
A-la-77-1-17	3.121	6.658	A-la-77-2-17	4.300	4.680
A-la-77-1-18	1.978	4.842	A-la-77-2-18	2.177	6.184
A-la-77-1-19	5.570	15.820	A-la-77-2-19	4.627	7.684
A-la-77-1-20	1.905	2.822	A-la-77-2-20	1.578	6.259
A-la-77-1-21	3.737	6.208	A-la-77-2-21	1.778	7.053
A-la-77-1-22	1.724	2.553	A-la-77-2-22	4.155	4.985
A-la-77-1-23	1.796	2.388	A-la-77-2-23	3.030	12.019
A-la-77-1-24	2.213	4.150	A-la-77-2-24	3.629	4.354
A-la-77-1-25	1.433	2.123	A-la-77-2-25	3.229	5.363

Grit temper	Shell Temper
Median = 5.537	Median = 6.184
Mean = 5.866	Mean = 6.683
Range = 14.471(1.349-15.820)	Range = 7.665(4.354-12.019)

Since the strength test required breaking the subject samples into halves, one half of each of the specimens was placed in the inundation site and measurements of porosity were conducted on the other halves. The specimens were weighed dry, then placed in a beaker of boiling water for 3.25 hours. After cooling at room temperature the specimens were weighed again, and the comparison resulted in a figure of percent of apparent porosity (Tables 3 and 4).

Table 3. Porosity of grit tempered ceramics

Catalog Number	Sf (gm)	Wf (gm)	Sf-Wf (gm)	Vf	P*
A-1a-77-1-1	4.79	4.14	.65	2.00	32.50
A-1a-77-1-2	3.57	2.96	.61	1.75	34.85
A-1a-77-1-3	3.81	3.19	.62	1.75	35.42
A-1a-77-1-4	4.11	3.61	.50	2.00	25.00
A-1a-77-1-5	4.40	3.74	.66	2.50	26.40
A-1a-77-1-6	2.98	2.55	.43	1.00	43.00
A-1a-77-1-7	3.95	3.49	.46	2.50	18.40
A-1a-77-1-8	5.89	5.18	.71	2.75	25.82
A-1a-77-1-9	2.60	2.25	.35	2.25	15.55
A-1a-77-1-10	4.17	3.60	.57	2.00	28.50
A-1a-77-1-11	5.06	4.30	.76	2.00	38.00
A-1a-77-1-12	5.22	4.55	.67	2.00	33.50
A-1a-77-1-13	3.17	2.71	.46	1.50	30.66
A-1a-77-1-14	4.85	4.16	.69	2.20	31.36
A-1a-77-1-15	4.64	3.98	.66	2.00	33.00
A-1a-77-1-16	5.28	4.53	.75	1.00	75.00
A-1a-77-1-17	3.80	3.35	.45	1.50	30.00
A-1a-77-1-18	3.36	2.86	.50	1.50	33.33
A-1a-77-1-19	4.51	3.91	.60	1.50	40.00
A-1a-77-1-20	5.12	4.41	.71	2.00	35.50
A-1a-77-1-21	4.76	4.14	.62	2.00	31.00
A-1a-77-1-22	5.70	4.63	1.07	2.50	42.80
A-1a-77-1-23	5.12	4.36	.76	2.00	38.00
A-1a-77-1-24	4.75	4.00	.75	2.00	37.50
A-1a-77-1-25	3.80	3.21	.59	2.00	29.50

Median = 33.00
Range = (15.55-75.00) = 59.45
Mean = 33.78
Standard deviation = 10.82

$$*P = \frac{Sf-Wf}{Vf} \times 100$$

Table 4. Porosity of shell tempered ceramics

Catalog Number	Sf (gm)	Wf (gm)	Sf-Wf (gm)	Vf (cc)	P*
A-la-77-2-1	3.85	3.18	.67	1.20	55.83
A-la-77-2-2	3.52	3.00	.52	1.25	41.60
A-la-77-2-3	5.93	4.90	1.03	2.50	41.20
A-la-77-2-4	5.59	4.78	.81	2.75	29.45
A-la-77-2-5	2.06	1.70	.36	0.75	48.00
A-la-77-2-6	3.42	2.93	.49	1.00	49.00
A-la-77-2-7	3.70	3.10	.60	1.50	40.00
A-la-77-2-8	4.17	3.37	.80	1.50	53.33
A-la-77-2-9	3.00	2.54	.46	1.20	38.33
A-la-77-2-10	3.80	3.10	.70	2.00	35.00
A-la-77-2-11	3.39	2.82	.57	1.50	38.00
A-la-77-2-12	2.30	1.87	.43	1.00	43.00
A-la-77-2-13	2.79	2.31	.48	1.00	48.00
A-la-77-2-14	4.84	3.86	.98	1.20	81.66
A-la-77-2-15	2.36	1.96	.38	1.00	38.00
A-la-77-2-16	3.76	2.96	.78	2.00	39.00
A-la-77-2-17	3.73	2.94	.79	2.00	39.50
A-la-77-2-18	2.84	2.40	.44	1.00	44.00
A-la-77-2-19	3.69	3.04	.65	0.75	86.66
A-la-77-2-20	3.55	3.05	.50	1.00	50.00
A-la-77-2-21	2.82	2.20	.62	1.50	41.33
A-la-77-2-22	4.05	3.40	.65	2.00	32.50
A-la-77-2-23	2.68	2.25	.43	1.00	43.00
A-la-77-2-24	3.69	3.03	.66	1.00	66.00
A-la-77-2-25	2.49	2.00	.49	1.25	39.20

Median = 41.60
Range = (29.45-86.66) = 57.21
Mean = 46.46
Standard deviation = 13.73

$$*P = \frac{Sf-Wf}{Vf} \times 100$$

OTHER SAMPLES

All other samples were prepared in the manner set forth in the research design, which need not be repeated here. Most of the experiments call for comparative samples to be placed in museum storage. Whenever possible this was done by cutting individual samples in half (bone, ceramics) or selecting control groups from the same provenience as the test groups. These materials will be stored at the Arkansas Archeological Survey laboratories in Fayetteville.

SOILS AND TRACE ELEMENT ANALYSIS

Soil samples were taken from profiles in units S90W88 and S96W88. These, and samples of the topsoil used in the experiments along with samples of bone material taken from the osteological samples have been subjected to chemical analysis. The methods and results of these analyses are presented in Appendix D.

SITE PREPARATION

SELECTION OF THE SITE AREA

As previously mentioned, the area selected as the site for the experiments was convenient to the Corps of Engineers Office at the dam. In addition, the area had to be free of any prehistoric artifacts which might be confused with the test samples (not an easy criterion to meet in a river valley which was heavily populated with aboriginal sites [Padgett 1977a]). The site chosen was a fairly flat area on the water's edge which, judging from the topographic maps made prior to the dam construction, had been used as a source of fill dirt for the dam. Following the state archeological site numbering system, the site was designated 3YEX (Yell County, experimental).

SPATIAL CONTROL

Two datums were established in areas outside the normal pool level. These were constructed of 1½ inch diameter plastic PVC pipe, 80 cm long. At the upper end of the pipe the words: DATUM #1(2), 3YEX, FEDERAL PROPERTY--DO NOT REMOVE, were scratched into the plastic and inked with black permanent marking pen. A similar datum (#3) was established at the edge of the site area. These datums were placed in holes 4 inches in diameter, sunk to half their length. The holes were then filled with concrete.

Datum #3 was used as the primary site datum and designated S100W100. All subsequent test units were measured in meters from this point. Unit S90W88, therefore, is located 10 m north and 12 m east of Datum #3. The southwest corner of each test unit was used to designate that unit, regardless of the dimensions of the unit (Fig. 4). A topographic map was made of the site area and referenced to the lake level elevation at the time the fieldwork was conducted (373.9 to 374.0 feet above mean sea level, or 113.96 m [see Fig.4]). The primary site datum was tied in to landmarks outside the lake area and to Datums 1 and 2. A transit oriented to magnetic north was used for all mapping procedures. Secondary datums, plastic surveyor's stakes, 37 cm long, were set in concrete at the southwest corner of each test unit.

DESCRIPTION OF TEST UNITS

A total of eight excavated test units and one surface unit were established at the site. Two ancillary pits, one at Datum 1 outside the site area and one at stake S100W84 were used for part of the

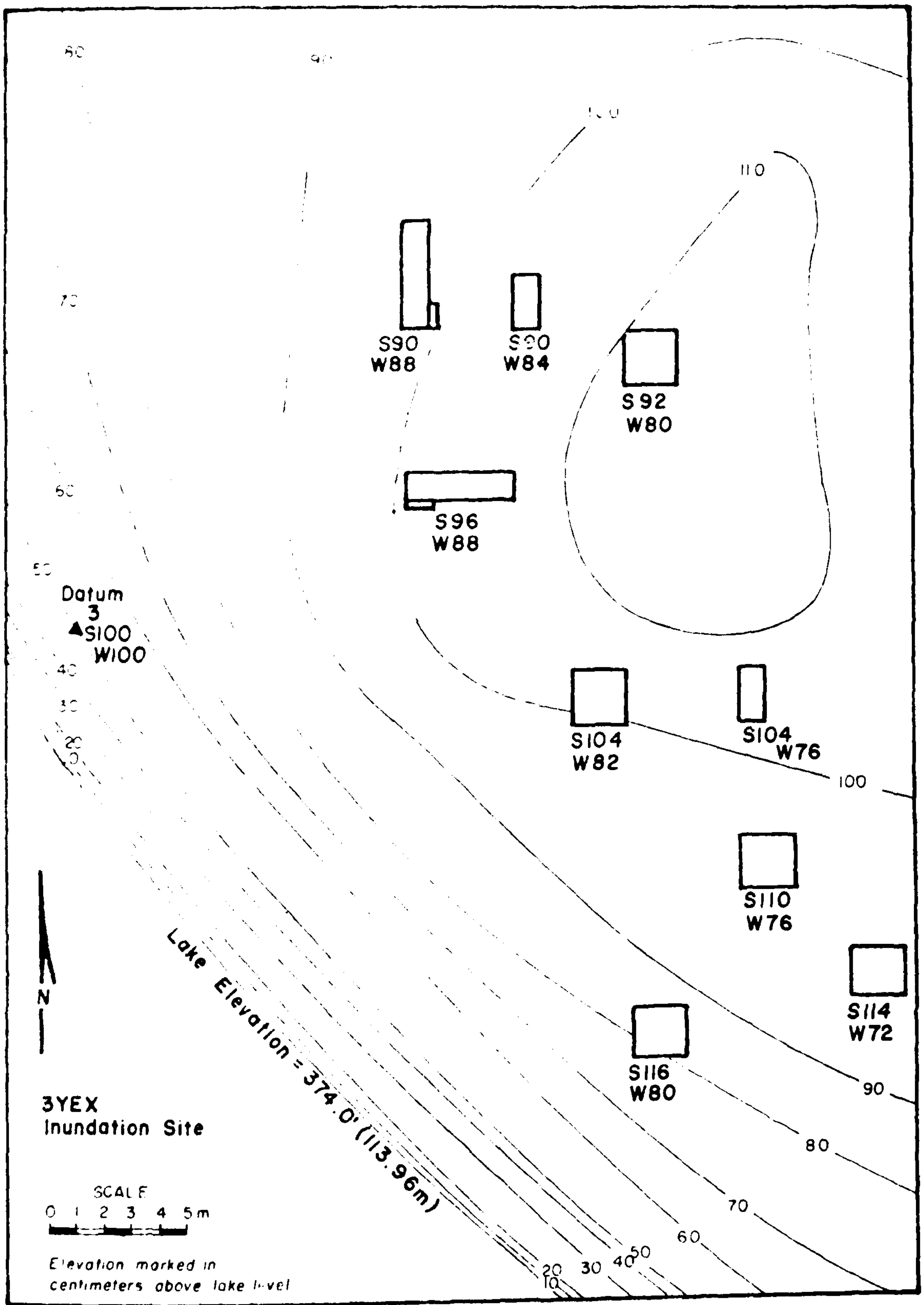

Figure 2. Site map, 3YEX, showing topography and site units.

tests on obsidian hydration. Units S90W88, S90W84, S92W80 were excavated by a backhoe using a 1 yard wide bucket. The remaining units were done with hand tools. Dimensions of the units varied, according to the purpose. A summary of the units and the samples contained in them is presented in Table 5.

Units S90W88 and S96W88 were used to create artificial soil profiles for tests of impacts of inundation upon archeological soil strata. The "dark black" soil shown on the profiles (Figs. 5 and 6) is commercial topsoil added to the natural soil profile to simulate organic midden deposits. This soil extends back from the profile 40 cm at the upper 15 cm of the profile, and approximately 10 cm back from the face of the profile in the lower features where the natural clay was carved out and the cavity filled with topsoil. The mixtures of red and yellow silty clays shown in the profiles represent Pope Silt loam which has probably been disturbed by construction machinery during the building of the dam, since the site is located in a "borrow" area. Artifacts, bone, and nuts were added to the profiles not only as test of artifact movement, but also to provide additional loci for tests of preservation (see below). Location of all visible artifacts and soil strata was marked on the plexiglass sheets abutting the profiles.

The north half of unit S92W80 was used for the deep obsidian hydration samples, placed at a depth of 73 cm below the surface. Another obsidian sample group was placed 5 cm deep at stake S100W84 and both deep (50 cm below surface) and shallow (10 cm below surface) samples were placed in the ancillary pit 1.5 m north of Datum 1, outside the normal pool level.

In the southern half of unit S92W80 were placed two shell tempered ceramic vessels containing corn and squash samples. The vessels (one small bottle of aboriginal manufacture with the neck broken off and one large jar manufactured in 1973 using aboriginal techniques) were both inverted (opening placed downward) before the pit was backfilled.

Unit S104W82 was used for the tests of differential preservation of materials. This unit was 10 cm deep and was divided in quadrants with the different materials listed in Table 6 placed in the quadrants so that recovery of any portion of the material can be undertaken without disturbing the other materials.

The materials placed in unit S104W76 are listed in Table 6. Two round pits were carefully excavated to the same dimensions (Fig. 7) and filled with the floral samples mixed in a matrix of commercial topsoil (the same soil used in the profiles in units S90W88 and S96W88). The pit in the northern half of the unit was capped with gray clay which was later fired (see below).

Table 5. Summary of tests units and samples.

Unit	Dimensions and Descriptions	Specimens Included and Accession Numbers
S90W88	1 x 4 m, 1.25 m deep, N-S long axis Artificial profile made for eastern wall at southern end (Fig. 5)	Miscellaneous bifaces, D-1-77-26 to 50 Squirrel skeleton (minus skull) A-3a-77-2 Whole walnuts, 300 gm, restorable vessel, shell tempered, D-1-77-3
S90W84	1 x 2 m, 40 cm deep, N-S long axis Divided in north (1 x 1 m) and south (1 x 1 m)	Iron bar, A-4-77-1 (north half of pit) Bone, shell, ceramics from Zebree site unit 96, level 6, 75-671 (see lab notes for complete listing)
S92W80	2 x 2 m, 75 cm deep, Divided into 1 x 1 m quadrants	NW - 25 black obsidian flakes, C-3-77-1 NE - 25 mahogany obsidian flakes, C-3-77-1 SW - whole vessel (large), D-2-77-1 with two ears of corn (538 gm) and two yellow squash SE - whole vessel (small, broken neck) with two yellow squash
S96W88	1 x 4 m, 1.15 deep, E-W long axis Artificial profile made in southern wall at western end (Fig. 6)	50 miscellaneous sherds, D-1-77-2 Miscellaneous bifaces, D-1-77-1 to 25
S104W82	2 x 2 m, 10 cm deep Divided into 1 x 1 m quadrants	NE - Bone, bobcat, A-3a-77-1 Human, A-3b-77-1 NW - 50 novaculite flakes, A-2-77-5 50 Peoria chert flakes, A-2-77-1 50 Boone chert flakes, A-2-77-3 SW - 21 shells, A-5-77-1 SE - 50 grit tempered sherds, A-1a-77-1-0 50 shell tempered sherds, A-1a-77-2-0 25 test sherds, grit tempered, A-1a-77-2-1 to 25 50 Pueblo B & W sherds, A-1b-77-1 to 50

Table 5. Summary of test units and samples, continued.

Unit	Dimensions and Descriptions	Specimens Included and Accession Numbers
S104W76		5 Varney Red Filmed sherds, A-1b-77-2-1 to 5 6 Larto Red Filmed sherds, A-1b-77-3-1 to 6
3104W76	1 x 2 m, N-S long axis 15 cm deep with 2 circular pits measuring 40 cm in dia. top and 30 cm in dia. bottom 18 cm deep	See Table
S110W76	2 x 2 m, 10 cm deep	Hearth, 60 cm dia., 20 cm deep, lined with gray clay
S116W80	2 x 2 m, 45 cm deep	Hearth, 60 cm dia., 10 cm deep, lined with gray clay Miscellaneous trash--aluminum and steel cans, bottles, etc. dumped in NW corner
S114W72	2 x 2 m, surface Divided into 1 x 1 m quadrants	NE - 25 large Peoria flakes, B-3b-77-2 NW - 25 obsidian flakes, B-3b-77-1 SE - 25 miscellaneous sherds, B-3b-77-1 SW - 25 small Peoria cherts, B-3b-77-3
Pit, Datum 1	Approximately 20 cm dia. pit located 1.5 m due north of Datum 1, 50 cm deep	25 obsidian flakes @ 50 cm deep, A-2-77-7 25 obsidian flakes @ 10 cm deep, A-2-77-7
Pit, ⌐100W84	50 cm dia. pit located 20 cm northeast of stake S100W84, 10 cm deep	25 mahogany obsidian flakes, C-3-77-2 25 black obsidian flakes, C-3-77-1

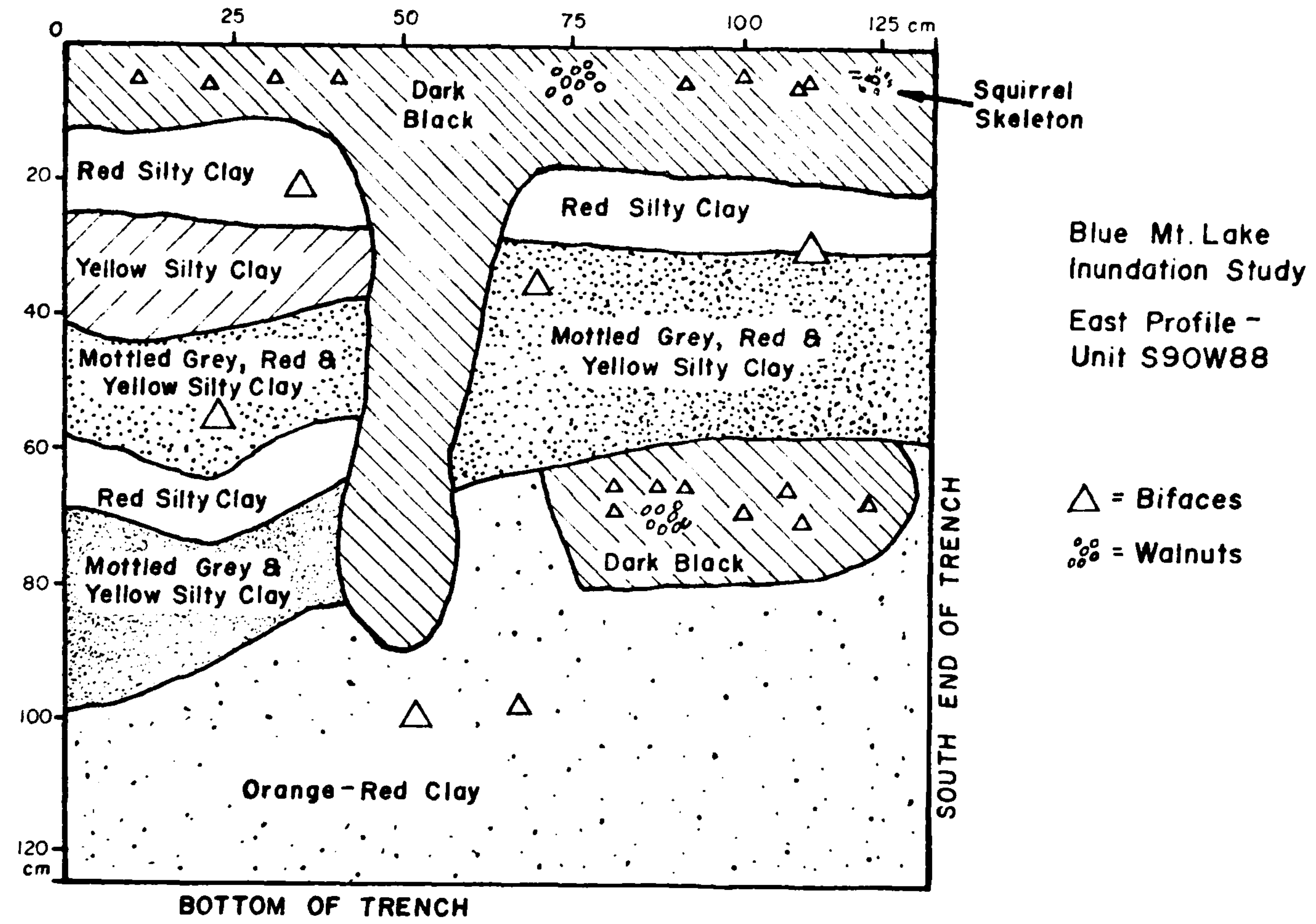

Figure 3. Soil profile, unit S90W88, 3YEX.

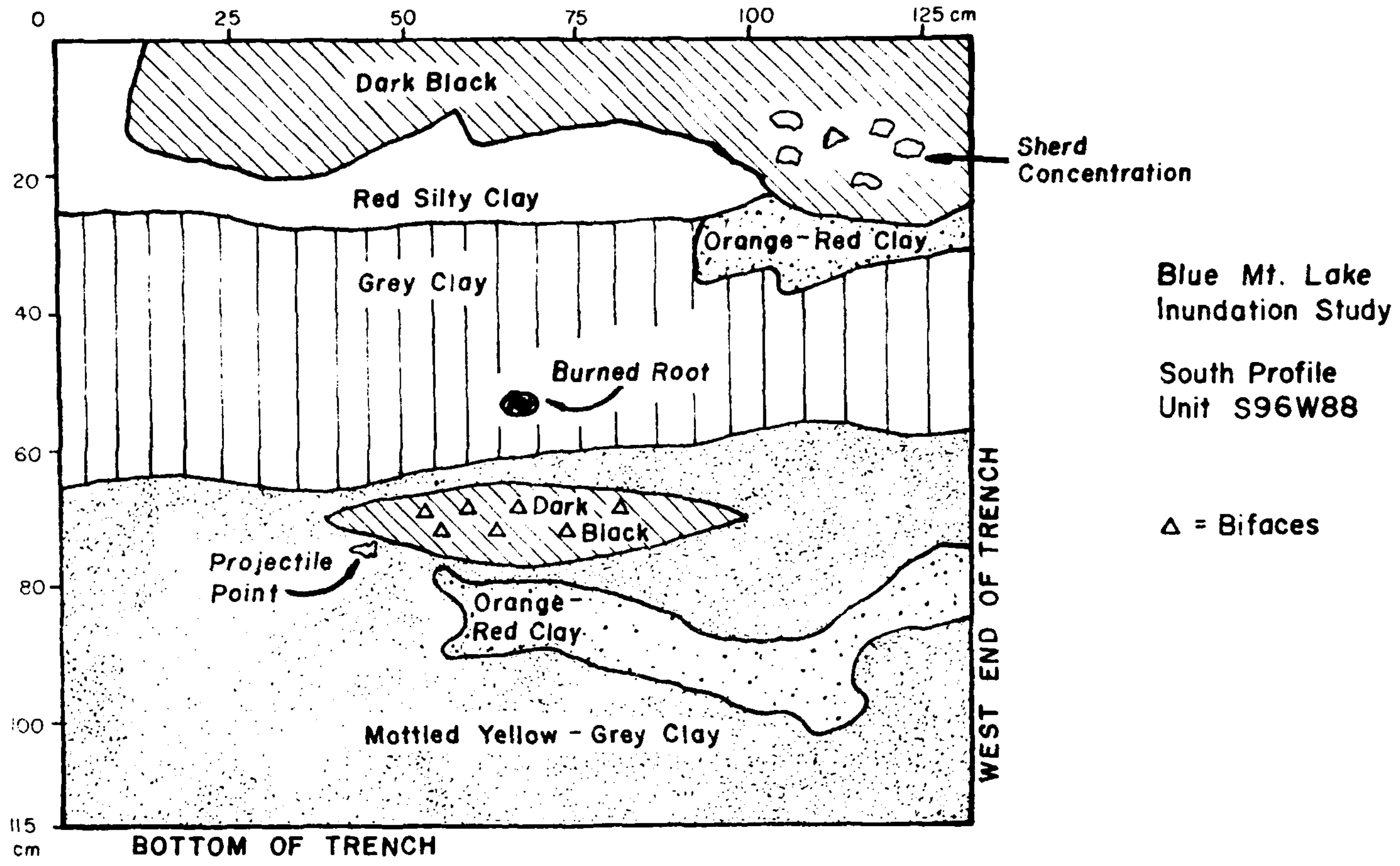

Figure 4. Soil profile, unit S96W88, 3YEX.

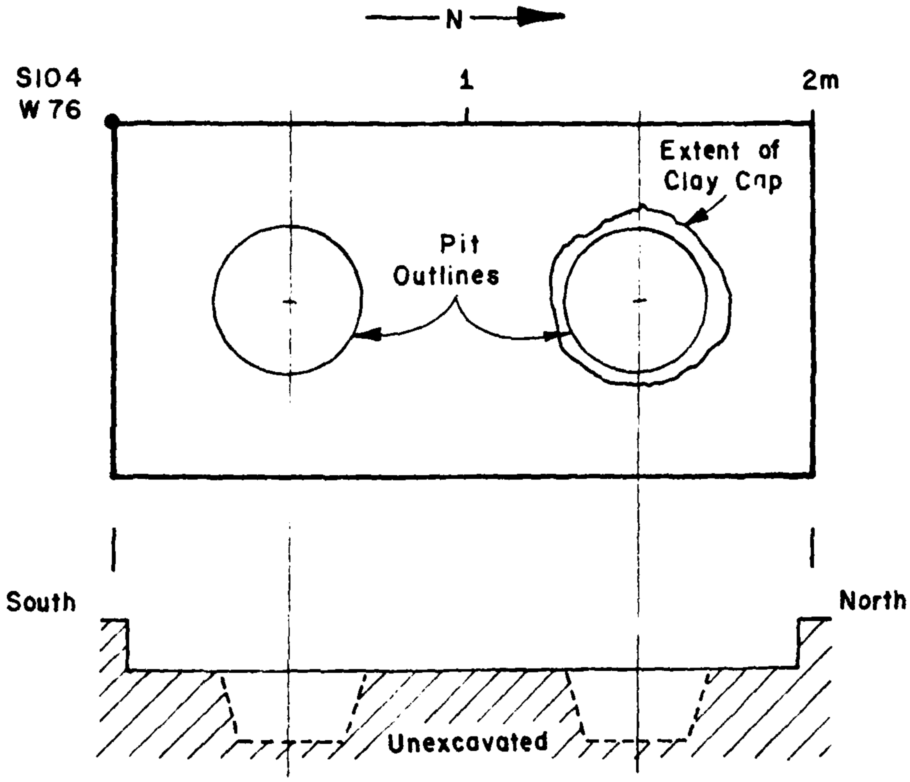

Figure 5. Unit S104W76, 3YEX, pit features.

Table 6. Unit S104W76 - Floral samples listed in gram weights

	North Pit Feature (clay capped)	South Pit Feature (uncapped)
Charred corn	56.05	56.85
Charred walnuts	111.32	111.33
Peach pits	39.06	39.00
Amaranth	18.89	18.65
Charred hickory	99.14	99.14
Chenopodium	18.85	18.85
Acorns (white oak)	52.00	52.00
Hickory	247.07	242.63
Walnuts (fragments)	63.65	63.65

A sample of archeological materials from a single provenience unit (square 96, level 6) from the excavations at the Zebree site (Morse and Morse n.d.) was placed in the south half of unit S90W84, at a depth of 40 cm. Although not included in the original research design, this material can be utilized to test the efficiency of underwater recovery techniques by comparing the recovery results with the techniques used to obtain the material from the original context (Anderson n.d.). The iron bar (also from the Zebree site) to be used for the test of corrosion of ferrous metals was placed in the north half of this unit.

The surface unit, S114W72, was divided into quadrants similar to S104W82 and a different category of material was placed in each 1 x 1 m section (see Table 5). This material was covered with a thin layer of soil (<2cm) to deter casual vandalism or displacement before the area is inundated. The material was not evenly spaced, as is suggested in the research design, but loosely grouped so that less covering soil could be used to adequately conceal the samples with less interference with the test.

Clay hearths were constructed in units S116W80 and S110W76 (Fig. 6). The clay used to line the hearths was obtained from a mud flat northeast of the site and was extremely plastic. No tempering agent was added, which proved to be a mistake. The hearths had to be repaired several times during the period in which they were drying since the clay had a tendency to crack. Keeping the hearths dry was also a problem because of the inclement weather which accompanied the fieldwork portion of the study. The hearths were left open for a period of 10 days after the completion of all other units, and an attempt to fire them was made at the end of that period. During this interval the lake level rose half a foot and

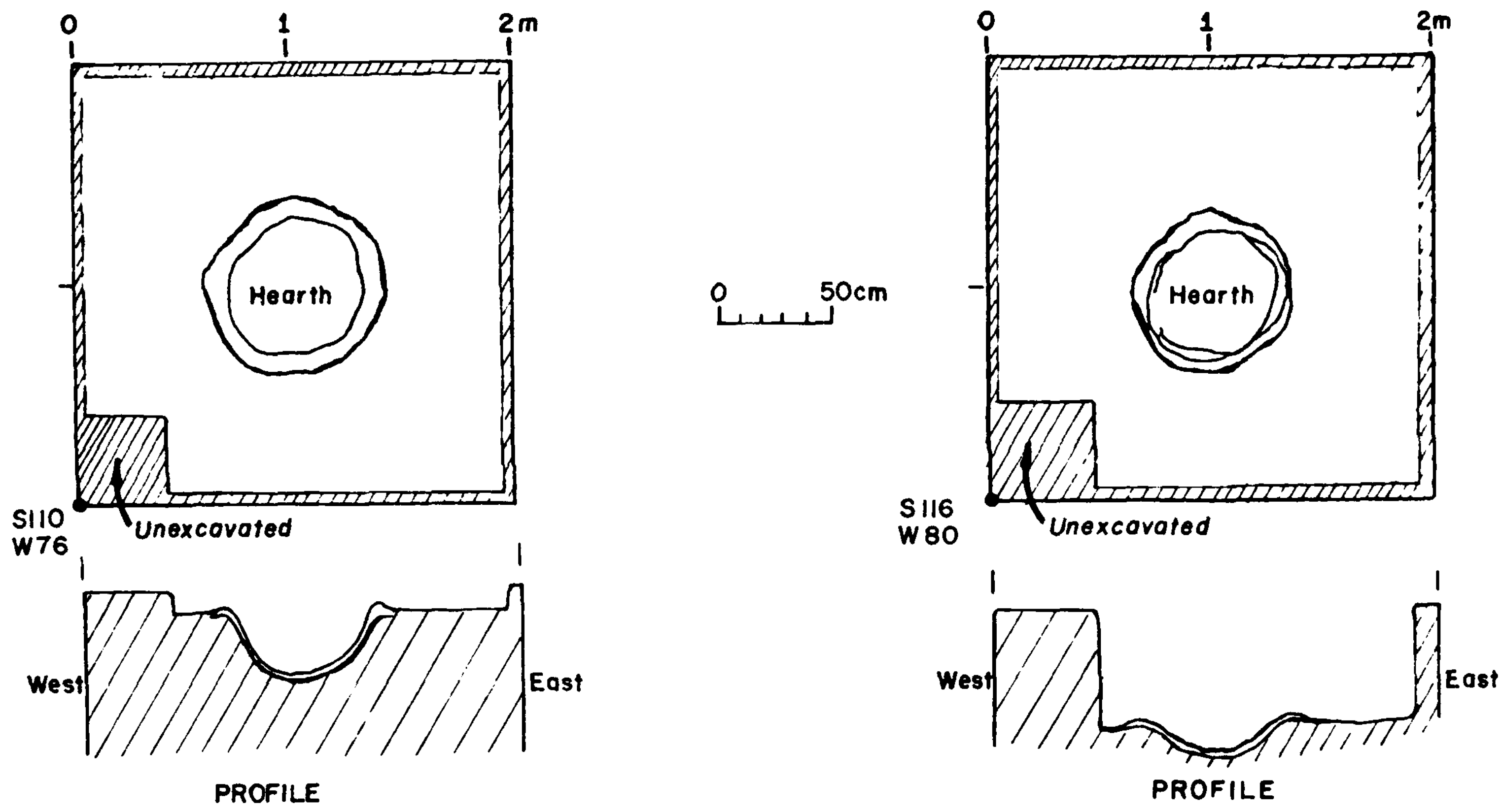

Figure 6. Units S110W76 and S116W80, 3YEX, Hearth features.

the deeper hearth (S116W80) was inundated by water seepage in the unit. Wood fires were started in the hearths (after S116W80 was bailed out) and also over the clay capped pit in unit S104W76 (which had been tempered with sand and sun-dried clay particles after that problem had been diagnosed). The fires were tended for six hours and a bed of coals was built up to keep the firing process going overnight.

A rainstorm that night extinguished the coals and inspection the next day showed that the hearths had cracked and spalled. The clay capped pit in S104W76 was essentially intact, although some cracking had occurred. This unit was backfilled, and the hearth units were partially backfilled. After discussing the situation with Dan Wolfman, it was decided that archeomagnetic dating samples from the hearth areas would be unlikely to produce accurate results. It is possible, however, that portions of the hearths were fired sufficiently before being doused, and, at any rate, the features may be used to experiment with underwater archeomagnetic sampling techniques. It may also be possible to use the charcoal and charred logs left in these features to test possible inundation effects on radiocarbon samples and wood preservation.

EVALUATION AND RECOMMENDATIONS

COMPLETENESS OF THE STUDY

The Blue Mountain Lake experiment was conceived as a broad range study to test effects of inundation upon archeological sites. The research design presented 14 separate tests, of which all but two were successfully set up during this study. The hearths to be used for archeomagnetic dating were not successfully fired intact, rendering them unsuitable for archeomagnetic samples. It will be interesting, however, to check these features in the future to see what physical impacts have occurred through inundation. The other test which was not set up involved placing ceramic samples in the experimental site for alpha recoil track testing. Adequate samples (i.e., large micaceous potsherds from a provenience unit that has been cross dated by other means) were not available at the time of this study. The Arkansas Archeological Survey is presently awaiting a continuation grant from the National Science Foundation to extend research into the potential of alpha recoil track dating techniques. When suitable samples are available, they can be dropped over a datum point at the inundated site.

Although the site test units in most cases are set up for particular tests, additional experiments may be devised for some units. For example, when the simulated soil profiles are inspected, some of the artifacts or organic remains should be collected to compare with the control groups in museum storage. The analytical techniques used in this study can, in most cases, be supplemented by other procedures when the inundated materials are recovered, since control groups of most specimens will be available.

ANCILLARY DATA SOURCES

Copies of the field notes and lab notes should remain on file at the National Park Service, Southwest Cultural Resources Center in Santa Fe as well as with the Arkansas Archeological Survey. These notes should be examined before the experimental site is reinvestigated.

Other sources of pertinent data include the Corps of Engineers and the Soil Conservation Service. The Corps of Engineers maintains records of the daily lake level and periodic readings of the water temperature, salinity, pH, turbidity, alkalinity, and measurements of a number of chemical elements. The Soil Conservation Service is currently remapping the soils of Yell County. These data should be examined when the results of the Blue Mountain Lake experimental study are compared with the results from similar studies in other reservoirs.

DATA RECOVERY AND MONITORING RECOMMENDATIONS

The initial inspection of the experimental site should be carried out by the Reservoir Inundation Studies team within two years. Since the site will be inundated by 10 to 12 feet of water (projected) at that time, this inspection will have to be carried out underwater. The extent of this inspection can vary, depending upon the underwater archeological methods used, but should include measuring displacement and/or siltation of surface artifacts, and recovery of some of the organic materials. The initial inspection of the site should not be an attempt to recover all the sample specimens. Measurable change in the more durable samples (lithics and ceramics) may not be detectable for many years.

It is also desirable to monitor the site at intervals for a number of years to detect changes and possibly derive rates of deterioration for various types of materials. Therefore, it is recommended that additional inspections be carried out by the Corps of Engineers or the Arkansas Archeological Survey after the tenure of the four year Reservoir Inundation Studies Project expires. The lake drawdown periods sponsored by the Arkansas Game and Fish Commission and the Army Corps of Engineers offer ideal chances to inspect the experimental site by conventional terrestrial archeological methods. The State Archeologist should be notified well in advance of the drawdown date in order to schedule the necessary fieldwork and arrange for security of the site once it is exposed.

APPENDIX A

This formed the contractual basis for the study funded by the National Park Service Inundation Study and the Arkansas Archeological Survey under agreement PX7029-7-0901, National Park Service, Southwest Region, Santa Fe, New Mexico.

PROPOSAL FOR AN EXPERIMENTAL STUDY OF THE EFFECTS OF INUNDATION UPON ARCHEOLOGICAL REMAINS

The National Park Service Inundation Study is a multi-agency project initiated to provice controlled studies of the effect of water impoundment projects upon cultural resources. The goal of this coordinated research program is to provide a broad data base to guide management decisions on the disposition of cultural resources within the impact zone of federal water-impoundment projects. An understanding of the mechanical and chemical effects of fresh water inundation upon cultural and environmental data is prerequisite to the development of alternative methods for mitigation of adverse effects. The study team has visited various reservoirs in different sections of the United States and has conducted field tests of specific archeological sites. Blue Mountain Lake, in west central Arkansas, offers a unique opportunity to conduct experiments within the framework of the Inundation Studies Research Design.

Blue Mountain Lake is located in Logan and Yell Counties, Arkansas. It is a small Corps of Engineers lake which covers 2,910 acres at conservation pool level. The lake was created in 1947 by the completion of Blue Mountain Dam on the Petit Jean River. As a result of a lake improvement project being carried out by the Corps of Engineers and the Arkansas Game and Fish Commission, the lake is currently down 10 ft below normal, exposing 1,500 to 2,000 acres of the lake bed. The lake is expected to remain at this level or slightly below this level until the end of the improvement project in November, 1977, when the lake will again be filled.

The Arkansas Archeological Survey, under a purchase order agreement with the Corps of Engineers, will conduct an archeological reconnaissance of the exposed lake bed to record and assess cultural resources. The lake was created in 1947 and no archeological work was done prior to inundation. This work will provide base data on the location and composition of the archeological sites in the lake area. The inundation study proposed here will be independent of the lake reconnaissance, but may use data gathered in that study.

It is proposed that the Arkansas Archeological Survey undertake an experimental study at Blue Mountain Lake to provide data to test hypotheses presented in the Inundation Studies Preliminary Report research design. This study will be based upon the creation of an archeological site in the currently exposed portion of the lake bed. This simulated archeological site can then be observed while inundated at some time within the next three years and can be rechecked at intervals in the future. Analyses and measurements will be carried out at the time the simulated archeological site is created and the results of these analyses will be submitted to the National Park Service for comparison with results obtained when the site is inspected in the future. The methods and techniques used will conform to studies being carried out at archeological sites in other areas as a part of the inundation studies program.

Tests to be conducted include differential preservation of osteological remains, ceramics, ferrous metals, stone, glass, and shell. Hypotheses concerning the preservation of these materials are listed in the Inundation Studies Preliminary Report research design, and the experiments will be conducted within that framework to insure comparability of data. Tests will also be devised to measure the loss of quantitative data relating to features, and the impact of inundation upon archeomagnetic and alpha-recoil track dating techniques.

The Arkansas Archeological Survey has the necessary expertise and access to specialized laboratory equipment required to conduct these experiments and analyses. The Survey maintains collections of archeological materials which can provide the experimental studies with a variety of subject materials.

The proposed study will be conducted in three phases. The first phase is a two week period during which a detailed project research design will be formulated listing each test to be conducted, the material and analytic procedures to be used, and the field and laboratory techniques to be employed. Preparation of specimens will be done in this period. The draft project research design will be submitted to the National Park Service for comment before the second phase begins. The second phase consists of the fieldwork portion of the project. Mapping, placement of samples, and preparation of the site for inundation will be accomplished in seven working days. In the third phase of the project the final report will be written and submitted to the National Park Service along with copies of the

AD-A124 230 BLUE MOUNTAIN LAKE: AN ARCHEOLOGICAL SURVEY AND AN EXPERIMENTAL STUDY OF INUNDATION IMPACTS(U) ARKANSAS ARCHEOLOGICAL SURVEY FAYETTEVILLE T J PADGETT FEB 78 2/2

UNCLASSIFIED RR-13 DACW03-77-M-1068 F/G 5/1 NL

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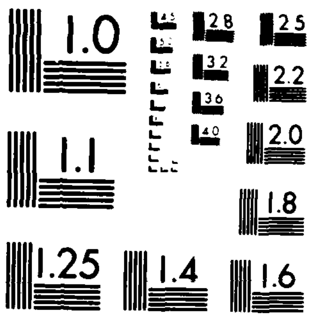

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

topographic, planimetric, and soil profile maps, description of procedures, photographic record, and other pertinent records of the project. Analysis of comparative, non-inundated samples will be conducted during this two week period.

It is hoped that Phase I of the project can be initiated on 12 September 1977. A two week break between Phase I and Phase II is anticipated to allow additional time for review and modification of the project research design. The fieldwork will be accomplished in seven days during the period 10 October - 21 October. The final report will be submitted to the National Park Service on or before 30 November 1977, 79 calendar days after the beginning date. Cost of the project is set forth in Financial Plan II (appended).

Tests to be Conducted in the Basic Project (Financial Plan I)

1) Preservation of Bone and Organic Material--Bone and other types of organic material (nuts, shell, seeds, etc.) commonly found in archeological sites will be placed in different contexts within the study site. Samples of the material will be analysed (identification, trace element analysis, osteological analysis) and placed in museum storage for comparison with identical analysis of inundated material after recover.

2) Impact on Archeomagnetic Dating Techniques--A suitable feature (baked clay hearth and/or clay floor) will be created at the study site. The feature will be oriented to permanent datum points to check for disorientation due to inundation and samples taken before inundation will be analysed for comparison with post-inundation samples.

3) Impact on Soil Features--Distinct soil features will be created in the study site using non-indigenous soils (e.g., potting soil, construction sand) to simulate features such as post molds, midden strata, etc., commonly found in archeological sites. These features will be mapped and the soil analysed (for phosphate, nitrogen, and trace elements prior to inundation for latter comparison.

4) Impact on Survey Techniques and Artifact Placement--Organic and non-organic materials of known weight and number will be placed in specific areas on the surface of the site to measure the degree of mechanical disturbance. Use of colored plastic stakes and flagging material to delineate these surface areas will facilitate relocation underwater.

A Supplemental Inundation Study

The tests listed above are but a few of the possible areas of research which could be approached in the experimental framework proposed here. If additional funding can be made available immediately after the beginning of the new fiscal year, a supplemental study may be carried out in conjunction with the basic project. The following list is an example of additional tests which could be carried out in a supplemental study. This work is not a part of this proposal, and additional funding as set forth in the appended Financial Plan II will be necessary to carry out these tests. These studies must be done in October as the lake will fill again in November.

Tests to be Completed in a Supplementary Study (Financial Plan II)

1) Impact upon Alpha-Recoil Tract Dating Techniques--Recent research conducted by the Arkansas Archeological Survey on alpha-recoil tract samples indicates that inundation may result in a distortion of results of the analysis of those specimens. Placement of analyzed specimens in the study sites to be reanalyzed after periods of inundation should result in further documentation of this impact and may result in refinement of techniques to obtain reliable dates using this relatively new dating method.

2) Preservation of Ceramics and Other Non-Organic Materials--Samples of different types of ceramics (with different tempering agents and surface treatment). lithics (including samples with documented use-wear, glass, and metals will be placed in subsurface and surface contexts to study the impacts of inundation over various time periods, assuming that some samples will be checked within three years and others will be left in place until the next draw-down period, and reanalyzed then.

3) Impact Upon Subsurface Features and Artifacts--This test will be carried out by excavating trenches and placing selected materials in soil profiles at various depths, then covering the profile with ¼" plexiglass and marking the plexiglass with the location of the materials and natural and/or created soil strata. One trench will be oriented parallel to the water flow (toward the dam outlet gates) and another will be oriented perpendicular to the water flow to determine if the flow of water affects subsurface features.

Key Personnel

Principal Investigator:	Dr. C. R. McGimsey III. Ph.D. 1957, Harvard. Director of the Arkansas Archeological Survey, Director of the U of A Museum, Professor of Anthropology, U of A.
Survey Archeologist:	Dr. Daniel Wolfman. Ph.D. 1973, University of Colorado. Special interests include dating methods in archeology (archeomagnetism, alpha-recoil track analysis, dendrochronology). Will collect and process samples for assessing impacts on dating methods.
Project Archeologist:	Thomas J. Padgett. M.S. 1973, Florida State University. Five years experience in conservation archeology. Author of numerous technical reports on archeological and historical resource studies conducted on contract with various state and federal agencies. Has conducted cultural resource mangement studies at two other Corps of Engineer reservoirs in Arkansas. Will be in charge of coordinating all research on the project and conducting the fieldwork.
Technical Assistant: (Jim Duncan)	The technical assistant will conduct some of the analyses (osteological, trace element analysis) and assist the project archeologist in directing laboratory processing of specimens.
Laboratory Technician:	Will process and catalog specimens, including photographing select specimens and preparation of samples for relocation by underwater technique.

FORM 10-131
(APRIL 1964)

PURCHASE ORDER

10-7-133

REQUISITION NO.
CR - Lenihan

THIS NUMBER MUST APPEAR ON ALL PACKAGES AND PAPERS RELATING TO THIS ORDER

DATE OF ORDER
September 8, 1977

ORDER NO.
PX7029-7-0901

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
SOUTHWEST REGION
P. O. Box 728
Santa Fe, New Mexico 87501
(ISSUING OFFICE)

ACCOUNTING CLASSIFICATION
7045-60?6-454 N 2500 $800.00
7045-6068-454 N 2500 $1,127.00
7045-6060-454 N 2500 $1,800.00

VENDOR'S NAME AND ADDRESS
Arkansas Archeological Survey
Attn: Dr. McGimsey III, & Mr. Padgett
Coordinating Office
University of Arkansas Museum
Fayetteville, AR 72701

SHIP TO (Consignee and Address)
Issuing Office

CONTRACT NO. O.M.

DISCOUNT TERMS Net

SHIP VIA n/a

DELIVERY F.O.B. SHIPPING POINT Santa Fe, NM

TIME FOR DELIVERY Dec. 15, 1977

GOVT. B/L NO. n/a

ITEM NO.	ARTICLES OR SERVICES	QUANTITY ORDERED	UNIT	UNIT PRICE	AMOUNT
1.	An experimental study of the effects of Inundation upon archeological remains in Blue Mountain Lake Arkansas	1	job		$3,727.00

Work under this contract shall consist of the following:

A. The contractor shall furnish all necessary personnel, facilities, equipment, materials, and transportation to perform the work described herein in a professional manner.

B. Costs of performing the Research will be shared by the Arkansas Archeological Survey according to the attached guidelines: (Financial Plan I).

C. Work will be conducted in accordance with the attached "Proposal for an Experimental Study of the Effects of Inundation upon Archeological Remains."

Payment Schedule: The Service agrees to pay the contractor for work performed on a reimbursable basis in accordance with the above provisions. Partial payment in the amount of two-thousand dollars ($2,000) to be made upon receipt and acceptance of final report due December 15, 1977. Total payment under this contract not to exceed three-thousand seven-hundred and twenty-seven dollars ($3,727.00).

Invoices and accounting documents shall be submitted to the contracting officer for payment. Project Director, Inundation Study, Southwest Cultural Resources Center, P.O. Box 728, Santa Fe, New Mexico, 87501, is designated as the Service's Contracting Officer's representative.

NOTE TO VENDOR: SUBMIT INVOICES IN ACCORDANCE WITH INSTRUCTIONS ON REVERSE SIDE HEREOF AND FORWARD TO ADDRESS SHOWN FOR ISSUING OFFICE UNLESS OTHER ADDRESS SHOWN BELOW:

TOTAL $3,727.00

SIGNATURE

NAME AND TITLE Delmar D. Scharn, Procurement and Property Management Specialist

PURCHASING OFFICER

1. ORIGINAL ORDER

Page 1 of 1

Order No. PX7029-7-0901

Date September 8, 1977

This purchase also is subject to the following Federal Procurement Regulations (Title 41, Code of Federal Regulations) provisions:

Regulation/Clause Title		When Required
1-12.1304-1	Employment of the Handicapped	Small purchases in excess of $2,500
1-12.303	Contract Work Hours and Safety Standards Act Overtime Compensation	Small purchases in excess of $2,500 not subject to Service-Contract Act of 1965
1-12.904-1	Service Contract Act of 1965	Service Contracts in excess of $2,500
1-12.904.2	Service Contract Act of 1965	Service Contracts not exceeding $2,500

(NOTE: Copies of these provisions are available on request from the issuing office.)

FINANCIAL PLAN I

		NPS	SURVEY
Survey Archeologist	1 day @ $70.00/day		$70.00
Project Archeologist	25 days @ $50.00/day	1,250.00	
Laboratory Technician	7 days @ $26.00/day	182.00	
Technical Assistant	7 days @ $36.00/day	252.00	
Field Crew Member	7 days @ $26.00/day	182.00	
Field Crew Member	7 days @ $26.00/day	182.00	
Draftsman	2 days @ $34.00/day		68.00
Typist	4 days @ $22.00/day		88.00
		$2,048.00	$226.00
Overhead	82% of Salaries and Wages	$1,679.00	$185.00
		$3,727.00	$411.00
Per diem (3 people for 7 days @ $25.00/day)			525.00
Travel			210.00
Supplies			300.00
Special Analyses			100.00
		$3,727.00	$1,546.00

Fred S. Vorsanger
Vice President for Fiscal Affairs
University of Arkansas

August 30, 1977

Charles R. McGimsey III.
Director
Arkansas Archeological Survey

8/30/77

FORM 10-131
(APRIL 1964)

PURCHASE ORDER

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

SOUTHWEST REGION
P. O. Box 728
Santa Fe, New Mexico 87501

(ISSUING OFFICE)

REQUISITION NO: CR - Lenihan

DATE OF ORDER: September 22, 1977

THIS NUMBER MUST APPEAR ON ALL PACKAGES AND PAPERS RELATING TO THIS ORDER

ORDER NO: AMENDMENT #1 PX7029-7-0901

ACCOUNTING CLASSIFICATION

VENDOR'S NAME AND ADDRESS

Arkansas Archeological Survey
Attn: Dr. McGimsey III, & Mr. Padgett
University of Arkansas Museum
Fayetteville, AR 72701

SHIP TO (Consignee and Address:)

Issuing Office

CONTRACT NO

DISCOUNT TERMS

SHIP VIA

DELIVERY F.O.B.

SHIPPING POINT

TIME FOR DELIVERY

GOVT. B/L NO.

ITEM NO	ARTICLES OR SERVICES	QUANTITY ORDERED	UNIT	UNIT PRICE	AMOUNT
1.	An experimental study of the effects of Inundation upon archeological remains in Blue Mountain Lake, Arkansas	1	job		$3,727.00

THIS AMENDMENT IS ISSUED TO REVISE PAYMENT SCHEDULE TO READ:

Payment Schedule: The Service agrees to pay the contractor for work performed on a reimbursable basis in accordance with the above provisions. Partial payment in the amount of two-thousand dollars ($2,000.00) to be made upon receipt of a letter stating that work has begun. Final payment of One-thousand seven-hundred and twenty-seven dollars ($1,727.00) to be made upon receipt and acceptance of final report due December 15. 1977.

TOTAL $3,727.00

NOTE TO VENDOR: SUBMIT INVOICES IN ACCORDANCE WITH INSTRUCTIONS ON REVERSE SIDE HEREOF AND FORWARD TO ADDRESS SHOWN FOR ISSUING OFFICE UNLESS OTHER ADDRESS SHOWN BELOW

SIGNATURE

NAME AND TITLE: Delmar D. Schafn, Procurement and Property Management Specialist

PURCHASING OFFICER

1. ORIGINAL ORDER

FORM 10-131
(APRIL 1964)

PURCHASE ORDER

OCT 31 1977

IU-8-2

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

Southwest Region
P.O. Box 728
Santa Fe, New Mexico 87501
(ISSUING OFFICE)

REQUISITION NO.	THIS NUMBER MUST APPEAR ON ALL PACKAGES AND PAPERS RELATING TO THIS ORDER
CR (Rikki)	
DATE OF ORDER: 10/11/77	ORDER NO.: PX7029-8-0016

ACCOUNTING CLASSIFICATION

7482-6058-454 N 2500 $2,213.00

VENDOR'S NAME AND ADDRESS

Arkansas Archeological Survey
Coordinating Office
University of Arkansas Museum
Fayetteville, AR 72701

SHIP TO (Consignee and Address)

National Park Service
Southwest Regional Office
P.O. Box 728
Santa Fe, New Mexico 87501

CONTRACT NO.	DISCOUNT TERMS	SHIP VIA
O.M.	Net	Your Option

DELIVERY F.O.B. SHIPPING POINT	TIME FOR DELIVERY	GOVT. B/L NO.
Destination	Final 12/15/77	N/A

ITEM NO.	ARTICLES OR SERVICES	QUANTITY ORDERED	UNIT	UNIT PRICE	AMOUNT
	An Experimental study of the effects of Inundation upon Archeological Remains in Blue Mountain Lake, Arkansas - A supplemental Study.	1	job		2,213.00

Work under this contract shall consist of the following:

1. The contractor shall furnish all necessary personnel, facilities, equipment, materials and transportation to perform the work described herein in a professional manner.

2. Costs of performing the research will be shared by the Arkansas Archeological Survey and the National Park Service according to the attached guidelines (Financial Plan II - Supplementary Study).

3. Work shall be conducted in accordance with the attached "Proposal for an Experimental Study of the Effects of Inundation upon Archeological Remains."

4. The results of work conducted under this supplementary study shall be included in the report to be prepared under contract PX7029-7-0901.

5. Payment Schedule: The Service agrees to pay the contractor for work performed on a reimbursable basis in accordance with the above general provisions. Final payment to be made upon receipt and acceptance of final report, due December 15, 1977. This shall be a cumulative report including the results of work performed under Financial Plan I. Total payment under this supplemental study contract not to exceed $2,213.00 (two-thousand two-hundred thirteen dollars).

Invoices and accounting documents shall be submitted to Project Director, ~~Inundation Study, P.O. Box 728, Santa Fe, New Mexico 87501~~

NOTE TO VENDOR: SUBMIT INVOICES IN ACCORDANCE WITH INSTRUCTIONS ON REVERSE SIDE HEREOF AND FORWARD TO ADDRESS SHOWN FOR ISSUING OFFICE UNLESS OTHER ADDRESS SHOWN BELOW

TOTAL $2,213.00

SIGNATURE

NAME AND TITLE Delmar D. Scharn, Procurement and Property Management Specialist
PURCHASING OFFICER

1. ORIGINAL ORDER

FINANCIAL PLAN II

Survey Archeologist	1 day @	$70.00		$70.00
Project Archeologist	15 days @	$50.00/day	$750.00	
Laboratory Technician	5 days @	$26.00/day	130.00	
Technical Assistant	5 days @	$26.00/day	180.00	
Field Crew Member	3 days @	$26.00/day	78.00	
Field Crew Member	3 days @	$26.00/day	78.00	
			$1,216.00	70.00
Overhead (82% of Salaries & Wages)			$ 997.00	57.00
			$2,213.00	$127.00
Per diem (3 people, 3 days @ $25.00/day				225.00
Travel				210.00
Supplies				180.00
Special Analyses				225.00
			$2,213.00	$967.00

8/30/77

APPENDIX B

CATALOG SYSTEM

The catalog system for the materials used in the experimental inundation study was devised to tie in with the research design culture. The outline of the research design and the catalog numbers assigned to materials used for particular tests is listed below. The system is open ended to accommodate multiple lots of material or individual specimens. Original catalog numbers were left on Zebree materials.

RESEARCH DESIGN

Research Design		Catalog Numbers
A. Differential Observation of Archeological Materials		
1) Ceramics	a) strength-porosity tests	A-1a-77-1,2....
	b) decoration tests	A-1b-77-1,2,3
2) Stone		A-2-77-1,2,3
3) Bone	a) deterioration	A-3a-77-1,2
	b) chemical alteration	A-3b-77-1
4) Ferrous Metal		A-4-77-1
5) Shell		A-5-77-1
B. Impact upon Analytical Techniques		
1) Soil Chemistry		B-1-77-1,2,3,4
2) Flotation		B-2-77-1
3) Survey Techniques		B-3-77-1,2....
C. Impact upon Dating Techniques		
1) Archeomagnetic Samples		not taken
2) Alpha-recoil Track		C-2-77-1
3) Obsidian Hydration		C-3-77-1,2
D. Impact upon Archeological Features		
1) Materials for Soil Profile		D-1-77-1,2,3
2) Whole Vessels		D-2-77-1,2

CATALOG NUMBER LIST

Part A

A-1a-77-1-0 = 25 grit sherds (storage)
50 grit sherds (inundated)
A-1a-77-1-1,...25 = 25 grit sherds (strength and porosity tested)
A-1a-77-2-0 = 25 shell sherds (storage)
50 shell sherds (inundated)
A-1a-77-2-1,...25 = 25 shell sherds (strength and porosity tested)

A-1b-77-1-1,...50 = 50 black and white sherds
A-1b-77-2-1,...50 = 50 Varney Red Filmed sherds
A-1b-77-3-1,...6 = 6 Larto Red Filmed sherds

A-2-77-1 = 100 large Peoria flakes
A-2-77-3 = 100 large Boone flakes
A-2-77-5 = 100 large novaculite flakes

A-3a-77-1 = bobcat bones
A-3a-77-2 = squirrel bones
A-3b-77-1 = human bones

A-4-77-1 = metal iron

A-5-77-1 = 42 shells

Part B

B-3a-77-1 = 50 misc. sherds (limestone and leached shell temper)
B-3b-77-1 = 50 small obsidian flakes
B-3b-77-2 = 50 large Peoria flakes
B-3b-77-3 = 50 small Peoria flakes

Part C

C-3-77-1 = 50 black obsidian flakes
C-3-77-2 = 50 mahogany obsidian flakes

Part D

D-1-77-1 = 50 bifaces
D-1-77-2 = 50 large miscellaneous sherds
D-1-77-3 = 1 broken point
D-2-77-1 = 2 pots (whole)

Weights (in grams) for 3MS20, Square 96, Level 6 (Zebree site material)

Catalog Number	Description	Number	Weight(gm)
75-671-1850	Bone fragments	118	29.74
75-671-1852	Ceramics ½" fragments	-	7.69
75-671-1853	Bone fragments	15	12.41
75-671-1854	Shell fragments	29	132.20
75-671-1857	Ceramics ½" fragments		90.86
75-671-1858	Mussell shell fragments	253	121.65
75-671-1860	Insect nest debris		6.74
75-671-2474	VRF body sherds*	18	97.59
75-671-2474	VRF body sherds*	30	370.31
75-671-2475	NFP body sherds**	9	17.62
75-671-2474	NFP body sherds**	16	159.41
75-671-2514	Barnes body sherds	10	66.37
75-671-2514	Barnes body sherds	7	22.17
75-671-2515	Barnes CM abrader	1	2.8
75-671-2516	Clay fragments	3	17.73
75-671-2516	Fired clay fragments	6	29.35
75-671-2517	ST clay fragments***	1	3.30
75-671-2624	Clay fragment	1	4.17
75-671-3836	Poss Incised Barnes sherd	1	1.15
76-16-5884	Shell		14.24
76-16-5886	Bone		3.81
76-16-5887	Red clay fragments	31	1.24
75-671-5890	Clay		178.69
75-671-5882	30 sherds		39.27
76-14	flotation artifacts		141.07

*VRF = Varney Red Filmed
**NFP = Neeley's Ferry Plain
***ST = Shell tempered

APPENDIX C

PHOTOGRAPHIC RECORDS

The photographic record of the Blue Mountain Lake experimental inundation study consists of a series of black and white prints and color slides documenting all phases of the laboratory and field procedures. Instead of using set photo stations at the experimental site, the camera position for each shot was recorded by reference to the grid system in use at the site. All site units are referenced by their distance in meters south and west of a theoretical datum located off the site. The primary site datum (Datum #3) was designated S100W100 and in practice all units and photographic stations were measured from that point.

The photographic record forms which follow are identified as to laboratory or field shots, and the individual photographs or slides are listed by catalog number.

ARKANSAS ARCHEOLOGICAL SURVEY
LAB PHOTO RECORD

PROJECT Blue Mountain Lake Inundation Study ROLL NO. 1

SITE NO(S). 3YE X CAMERA Pentax SLR

PROJECT DIRECTOR & FILM SIZE
PHOTOGRAPHER Padgett AND TYPE Extachrome 160

EXP. NO.	DATE	DIS-TANCE	[illegible]	[illegible]	[illegible]	NEGATIVE NUMBER
1	10/23	1.8m	55mm	.125 f5.6	Iron bar before treatmt	S-77-353
2	"	1.6m	"	"	" " " "	S-77-354
3	10/24	1.5m	"	.125 f1.8	Diamond Saw setup.	S-77-355
4	"	2.0m	"	.125 f2.8	Diamond Saw operation	S-77-356
5	10/27	1.75m	"	.125 f1.8	Work table with scale	S-77-357
6	"	0.7m	"	.250 f1.8	Fox Squirrel (no skull)	S-77-358
7	"	1.0m	"	.250 f1.8	Lynx Rufus (complete)	S-77-359
8	"	1.5m	"	.250 f1.8	Test lab Stress Analysis	S-77-360
9	"	1.1m	"	.250 f1.8	Shell tempered sherd in Stress Machine.	S-77-361
10	"	"	"	"	Above sherd broken.	S-77-362
11	"	1.0m	"	"	Gauge on Stress Machine.	S-77-363
12	"	4.9m	"	"	Appratus -- room.	S-77-364
13	"	1.19m	"	"	Broken Shell-tempered sh	S-77-365
14	"	"	"	"	" " " "	S-77-366
15	"	1.2m	"	"	Measurement guide.	S-77-367
16	"	"	"	"	Grit tempered sherd in Stress Machine.	S-77-368
17	"	"	"	"	Above sherd broken.	S-77-369
18	"	1.0m	"	"	Sample box.	S-77-370
19	"		"	1000 f2.8	Front of lab.	S-77-371
20	"		"	.500 f2.8	Side Entrance to Lab.	S-77-372

PRESERVING THE PAST FOR THE FUTURE

Date negatives submitted for processing: ________

Date prints and Negative Nos. received: ________

Date photo ID forms sent for Photo Files: ________

Date slide ID forms sent for Files & Neg. Nos.: ________

Date slide ID forms received with Neg. Nos.:

60

ARKANSAS ARCHEOLOGICAL SURVEY
FIELD PHOTO RECORD

PROJECT Blue Mountain Lake Inundation Study ROLL NO. 2

SITE NO(S). 3YEX

CAMERA Pentax SLR 55mm lens

PHOTOGRAPHER Padgett, T. Cochran, C.R. McKimmey

FILM SIZE AND TYPE Extachrome 200

EXP. NO.	DATE	DIRECTION	DESCRIPTION	NEGATIVE NUMBER
1	11/2	[illegible]	View of lake from tower.	S-77-314
2	11/3	[illegible]	Unit S104W82, Test A 1-5.	S-77-315
3	11/3	N	Same as above.	S-77-316
4	11/3	NE	Feature 2, Test C-1, hearth unit S116 W80.	S-77-317
5	11/3	NE	Feature 1 Test C-1, hearth unit S110 W74	S-77-318
6	11/4	[illegible]	Site & backhoe from Datum 1.	S-77-319
7	11/4	[illegible]	Same as above.	S-77-320
8	11/4	E	Backhoe in operation from Datum 3.	S-77-321
9	11/4	E	Backhoe in operation from Datum 3.	S-77-322
10	11/4	[illegible]	Unit S104 76 from stake S100W76.	S-77-323
11	11/4	[illegible]	Same as above.	S-77-324
12	11/4	S	Unit S104 76 w/ clay cap over ? pit.	S-77-325
13	11/4	S	Same as above.	S-77-326
14	11/4	S	Unit 96 88; profile being made.	S-77-327
15	11/4	S	Same as above.	S-77-328
16	11/4	E	Unit S90 88; profile being made.	S-77-329
17	11/4	S	Unit S96W88 completed, being mapped.'	S-77-330
18	11/4	E	Unit S90W8S being marked and completed	S-77-331
19	11/4	S	Unit S96 88 completed.	S-77-332

Date negatives submitted for processing:

Date prints and Negative Nos. received:

Date photo ID forms sent for Photo Files:

Date slide ID forms sent for Files & Neg. Nos.:

Date slide ID forms received with Neg. Nos.:

ARKANSAS ARCHEOLOGICAL SURVEY
LAB PHOTO RECORD

PROJECT Blue Mountain Lake Inundation Study ROLL NO. 3

SITE NO(S). 3YEX CAMERA Pentax SLR

PROJECT DIRECTOR & FILM SIZE

PHOTOGRAPHER T. Padgett AND TYPE Extachrome 160

EXP. NO.	DATE	DIS-TANCE	LENS	SETTING	SUBJECT	NEGATIVE NUMBER
1	11/1	68.1cm	55mm	.500@f2.8½	A-1a-77-1 - 50 tested sherds, grit.	S-77-373
2	11/1	68.1cm	55mm	.500@f4	Same as above	S-77-374
3	"	"	"	.500@f2.8½	Varney red-filmed sherds	S-77-375
4	"	"	"	"	Shell A-5-77-1.	S-77-376
5	"	"	"	"	Bobcat A-3a-77-1.	S-77-377
6	"	"	"	"	Hickorey, Peach, Corn, Amaranth, Acorn.	S-77-378
7	"	"	"	"	Assorted Bifaces D-1-77-1	S-77-379
8	"	"	"	"	Human bone A-3b-77-1 etc.	S-77-380
9	"	"	"	"	A-2-77-7. Obsidian Flakes.	S-77-381
10	"	"	"	"	A-2-77-1. Novaculite flakes.	S-77-382
11	"	"	"	"	A-2-77-1. Peoria chert flakes.	S-77-383
12	"	"	"	"	A-1a-77-1 Grit tempered sherds.	S-77-384
13	"	"	"	"	Squirrel bones.	S-77-385
14	"	"	"	"	A-1b-77-3-1 Larto red filmed sherds	S-77-386
15	"	"	"	"	D-1-77-2. Misc. sherds.	S-77-387
16	"	"	"	"	Charred Hickory (upper) Walnut (lower)	S-77-388
17	"	"	"	"	W. Million. Shell tempered pot	S-77-389

PRESERVING THE PAST FOR THE FUTURE

Date negatives submitted for processing: ________

Date prints and Negative Nos. received: ________

Date photo ID forms sent for Photo Files: ________

Date slide ID forms sent for Files & Neg. Nos.: ________

Date slide ID forms received with Neg. Nos.: ________

160

ARKANSAS ARCHEOLOGICAL SURVEY
FIELD PHOTO RECORD

PROJECT Blue Mountain Lake Inundation Study ROLL NO. 4

SITE NO(S). 3YEX CAMERA Pentax SLR 55mm lens

PHOTOGRAPHER Padgett, McGimsey, . Cochran FILM SIZE AND TYPE Ektachrome 200

EXP. NO.	DATE	DIREC-TION	DESCRIPTION	NEGATIVE NUMBER
1	11/4	E	View of work in progress from Datum 3.	-77-333
2	11/5	Down	View of Iron bar before placement.	S-77-334
3	11/5	"	View of improvised stadia rod.	S-77-335
4	11/5	E	S½ of unit S114W72 from S113.50 W70.50	S-77-336
5	11/5	E	N½ of " " " S112.50 W70.50	S-77-337
6	11/5	N	Pots and contents before placement.	S-77-338
7	11/5	N	Pots with contents within.	S-77-339
8	11/5	N	Pots with contents within.	S-77-340
9	11/5	S	Unit S92W80 before backfilling.	S-77-341
10	11/	S	" " " " from S90W79.	S-77-342
11	11/5	S	Unit S90W84 from S88 83.50.	S-77-343
12	11/5	S	Unit S110W76 before firing.	S-77-344
13	11/5		J. Cochran breaking wood for hearth firing.	S-77-345
14	11/5	S	"	S-77-346
15	11/5	SE	View of site from Datum 3, S100 100.	S-77-347
16	11/5	ESE	"	S-77-348
17	11/5	E	"	-77-349
18	11/5	W	"	S-77-350
19	11/5	N	"	S-77-351
20	11/5	NNW	"	S-77-352

Date negatives submitted for processing: ________

Date prints and Negative Nos. received: ________

Date photo ID forms sent for Photo Files: ________

Date slide ID forms sent for Files & Neg. Nos.: ________

Date slide ID forms received with Neg. Nos.:

ARKANSAS ARCHEOLOGICAL SURVEY
FIELD PHOTO RECORD

PROJECT Blue Mountain Lake Inundation Experiment ROLL NO. 5

SITE NO(S). 3YEX CAMERA Pentax 35mm lens

PHOTOGRAPHER T. Padgett FILM SIZE AND TYPE Ectachrome 200

EXP. NO.	DATE	DIREC-TION	PHOTO STATION	DESCRIPTION	NEGATIVE NUMBER
7	11-15-77	SE	Datum 3	View of when firing hearths	S-77-391
8	11-15	SE	Datum 3	same as above	S-77-392
9	11-15	SE	S100 W83	Fire over unit S104 W76	S-77-393
10	11-15	E	S109 W76	Fire in hearth--unit S110 W76	S-77-394
11	11-15	NE	S111 W77	same as above--different angle	S-77-395
12	11-15	E	S115 W80	Fire over hearth--unit S116 W80	S-77-396
13	11-15	E	S115 W80	same as above	S-77-397
14	11-16	NW	Dam outlet gate	View towards site (visible as 2nd point in center background)	S-77-398
15	11-16	S	South end of dam	Geological Strata at Blue Mountain Dam	S-77-399
16	11-16	S	same	same as above	S-77-400
17	11-16	W	same	View of Blue Mountain Lake	S-77-401
18	11-16	E	same	View of Peiti Jean River Valley	S-77-402
19	11-16	N	same	Top of Blue Mountain Dam with	S-77-403
				Magazine Mountain in background	S-77-404

Date negatives submitted for processing: ____________

Date prints and Negative Nos. received: ____________

Date photo ID forms sent for Photo Files: ____________

Date slide ID forms sent for Files & Neg. Nos.: ____________

Date slide ID forms received with Neg. Nos.: ____________

ARKANSAS ARCHEOLOGICAL SURVEY
LAB PHOTO RECORD

PROJECT Blue Mountain Lake Inundation Experiment ROLL NO. Misc. 275

SITE NO(S). 3YEY CAMERA Pentax 35mm

PROJECT DIRECTOR & FILM SIZE

PHOTOGRAPHER T. J. Padgett--J. Duncan AND TYPE Plus X 135mm

EXP. NO.	DATE	DIS-TANCE	LENS	SETTING	SUBJECT	NEGATIVE NUMBER
1	10-27-77	1.5m	55m		Stress analyser with sherd breaking	774594
2	10-27	< 1m	55m		Sherd positioned in stress analyzer	774595
3	10-29	< 1m	55m		Gauging apparatus--Stress analyzer	774596
4	11-1-77	68cm	55m	f2.8 @ 500	Restorable vessel--D-1-77-3	774597
5	11-1-77	68cm	55m	f28. @ 500	Charred corm sample	774598
6	11-1-77	"	"	"	Bifaces--D-1-77-1...	774599
7	11-1-77	"	"	"	Bifaces--D-1-77-1...	7745600
8	11-1-77	"	"	"	Partially charred Ammoranth seeds	7745601
9	11-1-77	"	"	"	Whole walnuts	7745602
10	11-1-77	"	"	"	Partially charred Walnut fragments	7745603
11	11-1-77	"	"	"	Peach pits and acorns	774604
12	11-1-77	"	"	"	Bone samples (Human) A-3b-77-1-1 to 10	7745605
13	11-1-77	"	"	"	Bobcat (Lynx rufus) A-3a-77-1	7745606
14	11-1-77	"	"	"	Fox squirrel (no skull) A-3a-77-2	774607

PRESERVING THE PAST FOR THE FUTURE

Date negatives submitted for processing: 11-1-77

Date prints and Negative Nos. received: 12-2-77

Date photo ID forms sent for Photo Files: 12-8-77

Date slide ID forms sent for Files & Neg. Nos.: ____________

Date slide ID forms received with Neg. Nos.: ____________

ARKANSAS ARCHEOLOGICAL SURVEY
FIELD PHOTO RECORD

PROJECT Blue Mountain Lake Inundation Experiment ROLL NO. Misc. 276

SITE NO(S). 3YEX CAMERA Pentax 35mm lens

PHOTOGRAPHER Padgett, Cochran FILM SIZE AND TYPE Plus X 125

EXP. NO.	DATE	DIRECTION	PHOTO STATION	DESCRIPTION	NEGATIVE NUMBER
9	11-2-77	SW		Blue Mountain Lake from site area	774616
10	11-2-77	W		Climatic conditions during field work	774617
11	11-2-77	N	S104 W81	Unit S104 W82 with samples	774618
12	11-2-77	N	S104 W81	same as above	774619
13	11-2-77	NE	S116 W80	Hearth in unit S116 W80	774620
14	11-2-77	NE	S110 W76	Hearth in unit S110 W76	774621
15	11-2-77	N	S105 W751/2	Pit features, unit S104 W76	774622
16	11-3-77	W	S100 W84	Transit over Datum 3	774623
17	11-4-77	NW	Datum 1	View of site area (backhoe working)	774624
18	11-4-77	E	Datum 3	Backhoe digging S96 W88	774625
19	11-4-77	E	Datum 3	same as above	774626
20	11-4-77	NE	Datum 3	Directing backhoe work	774627

Date negatives submitted for processing: 11-7-77

Date prints and Negative Nos. received: 12-2-77

Date photo ID forms sent for Photo Files: 12-8-77

Date slide ID forms sent for Files & Neg. Nos.:

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ARKANSAS ARCHEOLOGICAL SURVEY
FIELD PHOTO RECORD

PROJECT Blue Mountain Lake Inundation Experiment ROLL NO. Misc. 277

SITE NO(S). 3 YE X CAMERA Pentax--35 mm lens

PHOTOGRAPHER T. Padgett FILM SIZE AND TYPE Plus X 135 mm

EXP. NO.	DATE	DIREC-TION	PHOTO STATION	DESCRIPTION	NEGATIVE NUMBER
1	11-3-77	S	S100 W76	Unit S104 W76 with samples in place	774628
2	11-3-77	S	S100 W76	Unit S104 W76 with clay cap on pit	774629
3	11-4-77	SE	S95 W89	Unit S96 W88 profile with plexiglass	774630
4	11-4-77	E	S90 W89	Unit S90 W88 profile before completion	774631
5	11-4-77	E	S90 W89	Like above, note squirrel bones near top right of glass	774632
6	11-4-77	E	S90 W89	Unit S90 W88 marking plexiglass	774633
7	11-4-77	SE	S95 W89	Unit S95 W88 mapping profile	774634
8	11-4-77			Iron bar (A-4-77-1) before placement	774635
9	11-4-77			observe iron bar (A-44-77-1)	774636
10	11-4-77	E	S113 1/2 W71	south half of Unit S114 W72 with samples	774637
11	11-4-77	E	S112 1/2 W71	north half of unit S114 W72 with samples	774638
12	11-4-77	N	S93 W79	Ceramic vessels with corn and squash outside	774639
13	11-4-77			Ceramic vessels with corn and squash inside	774640
14	11-4-77	S	S90 W79	Inverted pots placed in Unit S92 W80	774641
15	11-4-77	S	S87 W83 1/2	Unit S90 W84 with Zebree samples and iron bar	774642
16	11-5-77	E	Datum 3	View of site nearing completion	774643
17	11-5-77	SE	Datum 3	View of site and dam outlet gate in background	774644

Date negatives submitted for processing: 11-7-77

Date prints and Negative Nos. received: 12-2-77

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APPENDIX D

RESULTS OF SOIL ANALYSIS AND TRACE ELEMENT ANALYSIS OF BONE

James E. Duncan

INTRODUCTION

The following covers two different types of material: bone and soil. These materials are handled in the same basic manner for the trace element analysis. The first section of this report deals with trace element analysis and the second section covers soil analysis other than trace element analysis. The result to date of all tests appears in table form in these sections.

All of the analyses were completed by the State Soil Laboratory located at the University of Arkansas Farm, Fayetteville, Arkansas.

ATOMIC ABSORPTION FLAME SPECTROPHOTOMETRY (AAS)

In the book *Detection and Determination of Trace Elements*, Maurice Pinta defines AAS as being possible because:

> When a special radiation of a given frequency passes through a closed space containing atoms, the resonance effects are accompanied by an absorption of the incident radiation, and the intensity of the radiation is thus decreased. The atoms give an absorption line spectrum corresponding to their resonance frequencies (1962:279).

This is, in effect, the same process as flame emission in that the line spectrum is measured for each element. However, in AAS a more exacting analysis of material is possible because the element to be measured is isolated by a light beam of established frequency. This light beam is measured for change after passing through the flame rather than measuring radiation from the flame directly.

The preparation of material to be processed is described in the following section of this report. The material is then siphoned up a small capillary tube to the flame (hydrogen-oxygen) and the lamp (light source) for each element is projected through the flame. The lamps for the elements are projected one at a time for each sample. The resulting absorption of the projected beam is measured and the proportion of the element in the sample is displayed as parts per million or as percentage of sample. The latter applies if the element to be measured is over .01% of the usual make-up of the material under analysis.

METHODOLOGY

Bone sample selection. From the squirrel (A-3a-77-2), one half of both the tibia and fibula were selected. From the lynx (A-3a-77-1), portions used are one-half of the tibia and radius.

The human materials used were a section of the tibia (A-3b-77-1-1), and a section of the tibia (A-3b-77-1-2).

The selected material of each sample was obtained by removing the indicated portion with a jeweler's saw. The human samples measured 4 cm by 2 cm. One half of each sample was retained for further study.

Cortexual removal. None of the samples had been chemically preserved so no depreservative procedures were required, but the possibility of contamination required the removal of the cortex.

The possibility of contamination by exposure to air is considered by Pinta (1962), Gilbert (1975), and Brown (1973) to be of considerable importance. This is especially true of material which has been stored for a long time on open shelves or in paper boxes. Gilbert postulates a method for the removal of the exposed area of the sample (Gilbert, 1975, p. 154). We extended this idea to include the removal of any contamination incurred in handling the material.

Sterile glass slides were used to scrape the cortexual layer from the bone sample. Each slide was broken to gain a sharper edge. When the slide was dulled it was replaced. For every sample new slides were used.

During this process the samples were held only with polyethylene gloves. The use of gloves was constant from this point on. Gloves were worn not only when handling the sample but also when handling any material with which the sample would come into contact. After the sample was scraped, its weight was recorded (to the nearest hundredth of a gram) and it was stored in a new polyethylene bag. Gloves were rinsed in distilled deionized water and dried with Kim-wipes between each preparation.

Grinding of samples. Gilbert (1975) reported that he used a steel grinder for the processing of bone into a readily digestible state. Other researchers (Pinta 1962) suggest that the steel may contaminate the sample. Research at the University of Arkansas Soil Laboratory has tended to confirm this.

The sample was therefore placed in a porcelain mortar and pulverized with a porcelain pestle. Such powdered remains passed easily through a 100 mesh screen. This is the size recommended for further processing.

The resulting powder was then poured into a polyethylene bag and the accompanying identification card attached. The mortar and pestle were cleaned between each grinding with distilled deionized water and dried with Kim-wipes. It is possible never to handle the samples during this process.

Ashing the sample. The ground sample was then ashed. This heating causes a breakdown in most organic compounds and boils off any remaining moisture. The larger molecules of organic compounds can result in false reading unless broken down. This is especially important in trace element studies.

The samples were put into covered crucibles of glazed porcelain. and were then placed at predetermined positions in the oven so that identification could be accomplished without the introduction of any new contaminants into the oven. The oven was preheated to 400°C and the samples were heated for 24 hours. At this temperature the larger molecules reduce without bringing the compounds to a boil. Such boiling would result in the loss of certain elements in vapor form.

After 48 hours the oven was shut down and the door opened. The samples cooled in place 6 to 8 hours. The samples were then placed into polyethylene bags with attached identification cards.

Digestion of the sample. The process of digestion was used after ashing to further reduce the material into individual elements or into extremely simple compounds which could be used by the measuring device with little error. Samples of 1 gram from each bag were selected for digestion.

Hydrochloric acid (HCL) was used as the digestive agent. Gilbert (1975) and others have used nitric acid (N_2O) but the Soil Laboratory thought that the standards they used obtained the best results with the HCL. The 1 gram sample was placed into a volumetric flask (50 ml) and 4 ml of HCL acid was added. This was followed immediately by enough distilled deionized water to fill the flask to the 50 ml mark. The flask was covered and shaken to help in the digestion of the material.

The digested material was then poured into polyethylene bottles to stand at least 24 hours to allow the complete digestion of the bone--if possible--and the settlement of any particles which might not have digested. The resulting solution of bone contains a percentage of material which does not succumb to ashing or digestion. This material appears as a precipitant in the bottom of the bottle. The Soil Lab informed this investigator that this was often a problem with certain soil and vegetable samples. This problem can be solved either by filtering or by decanting from the top of the bottle.

We chose the decantation method as the one least likely to contaminate the material and proceeded by decanting the digested material from the top half of the bottle. This decantation was accomplished by capillary tube.

METHODOLOGY - SOIL SAMPLES

Soils selection. Nine soil samples were analyzed. These samples are portions of the samples taken from the site and one sample of the organic top soil used in site construction. One half of each sample was retained for further study.

Table I. Soil Samples Provenience

Specimen Number	Site Unit Location	Position	Depth
A1a	590W88	West profile	10 cm
A2a	590W88		26 cm
A3a	590W88		50 cm
A4a	590W88		100 cm
B1a	596W88		10 cm
B2a	596W88		50 cm
B3a	596W88		75 cm
B4a	596W88	North profile	100 cm
C10a	Organic topsoil used for midden simulation		

Soil dehydration. The soil was placed in an oven in a vented container and the heat set to 400 degrees centigrade for 4 to 6 hours. This process removed all water as vapor and broke down many organic compounds.

Digestion of the sample. The sample was then digested with hydrochloric acid (HCL). A 1 gram sample was placed into a volumetric flask (50 ml) and 4 ml of HCL was added. Followed by enough distilled deionized water to fill the flask to the 50 ml mark.

Filtration of the sample. The sample is then filtered through vacuumed filter paper to remove the undigested portions and the remaining sample collected in a polyethylene bottle for analysis.

RESULTS

Bone trace elements. The results of the trace element analysis of bone samples have not been received from the laboratory at this time. Results of those analyses will be submitted to the National Park Service, Southwest Cultural Resources Center when they are obtained and records will be maintained at the Arkansas Archeological Survey Coordinating Office.

Soil trace element analysis. The results of the chemical trace element analysis of the soil samples is listed in Table II.

Table II. Soil Analysis Results - Trace Elements.

	Specimen Number	A1a	A2a	A3a	A4a	B1a	B2a	B3a	B4a	C10a
Percentage	N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40
	P	<.10	<.10	<.10	<.10	<.10	<.10	<.10	<.10	<.10
	K	0.80	0.84	0.40	0.48	0.82	0.52	0.52	0.49	0.12
	Ca	0.02	0.03	0.12	0.03	0.06	0.05	0.02	0.10	2.05
	Mg	0.05	0.02	0.01	0.02	0.02	0.02	0.04	0.01	0.31
	Na	0.12	0.13	0.09	0.12	0.12	0.10	0.11	0.10	0.08
Parts per million	Cu	5.7	6.0	6.1	5.2	5.8	5.2	5.7	5.5	7.7
	Zn	47.5	43.5	48.7	38.5	42.7	43.4	37.3	37.7	21.9
	Fe	10200	6560	10220	8340	7680	13800	13660	13000	9640
	Mn	510	251	1036	1080	175	1720	1560	1240	217
	Pb	0.45	0.29	0.40	0.25	0.30	0.43	0.27	0.33	0.20
	Sr	0.14	0.10	0.09	0.17	0.11	0.11	0.12	0.12	0.20

OTHER TESTS FOR SOIL ANALYSIS

Certain aspects of soil are important in an archeological context. Other aspects appear interesting but at this time may not be directly applicable to the work of archeology. The tests listed below were run in conjunction with the trace element analyses. Some of them are not directly needed for the original research design but in the future they may be of some importance. The results of these tests are summarized in Table III.

Table III. Soil [illegible]

Specimen Number	A1a	A2a	A3a	A4a	B1a	B2a	B3a	B4a	C10a
Wet Wt.	197.5	20[illegible]	195.8	18[illegible]	1[illegible].7	195.[illegible]	164.3	202.1	194.5
Dry Wt.	183.3	138.5	1[illegible]4.9	16[illegible].6	[illegible]	180.9	153.9	184.7	122.[illegible]
pH	5.6	5.7	6.5	[illegible].5	5.3	6.6	6.5	6.3	5.7
% Organ.	.71	[illegible]	.[illegible]	.72	1.[illegible]	.80	.80	.45	4.00+
Ec x 10^3	0.06	0.[illegible]6	[illegible]	0.15	0.[illegible]8	0.09	0.10	0.10	1.02

The percent of the organic material contained in the sample was made by transmittance comparison level readings before the heating of the soil to break down the organic compounds and burn off the organic materials. Soil pH and conductivity were determined by a Marksman Expanded Scale pH and conductivity meter. Organic material percentage transmittance levels were made on Bausch and Lomb colorimeter.

The soil conductivity (Ec x 10^3) readings in Table III are in milli mhos = 1/r, where r = ohms. The conductivity of the soil may be directly related to the amount of salts the soil contains which could, of course, also affect the materials interred in the soil. Wet and dry weights were obtained by weighting the samples before and after the dehydration process described above as part of the AAS sample preparation.

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